From the Department of Oncology and Pathology and the division of
Clinical Cancer Epidemiology
Karolinska Institute, Stockholm, Sweden

SELF PERFORMED TREATMENT IN FEMALE CANCER SURVIVORS WITH SECONDARY LYMPHEDEMA

Helene Lindquist

Karolinska Institutet

Stockholm 2015

Published by Karolinska Institute.
Printed by Eprinter KI

ISBN 978-91-7549-993-2

SELF PERFORMED TREATMENT IN FEMALE CANCER SURVIVORS WITH SECONDARY LYMPHEDEMA

THESIS FOR DOCTORAL DEGREE (Ph.D.)

From Karolinska Institutet to be publicity defended in, Skandiasalen, at Karolinska University hospital, Sweden

October, 1st, 10.00 AM

By

Helene Lindquist

Principal Supervisor:
PhD Karin Bergmark
Karolinska Institutet
Department of Clinical Cancer Epidemiology
Division of Oncology and Pathology

Co-supervisor(s):
PhD Anna Enblom
Karolinska Institute
Department of Clinical Neuroscience
Division of Psychology, Osher centrum

PhD Gail Dunberger
Ersta Sköndal University College
Department of Health Care Sciences

Opponent:
Associate Professor Karin Ahlberg
Gothenburg University, Sahlgrenska Academy
Department of Health Care Sciences

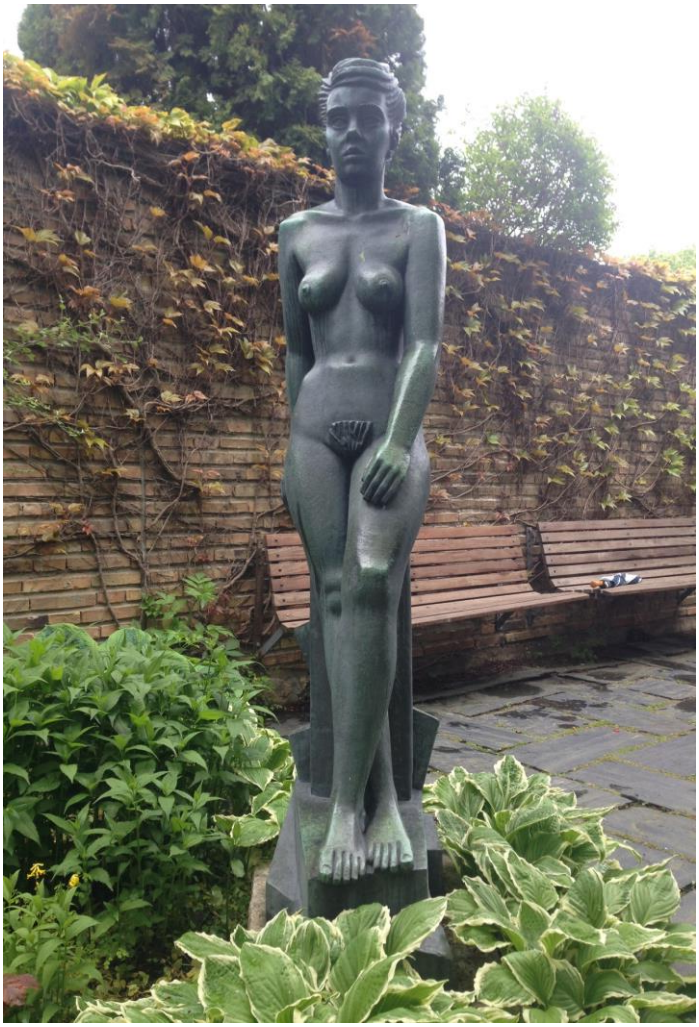
Examination Board:
Associate Professor Karin Johansson
Lund University
Department of Health and Sciences
Division of Physiotherapy

Associate Professor Leif Perbeck
Karolinska Institute
Department for Molecular Medicine and Surgery
Division of Breast surgery

Professor Pernilla Lagergren
Karolinska Institute
Department of Molecular Medicine and Surgery
Division of Surgical Care Science

To female cancer survivors with secondary lymphedema:

Freedom is to be in presence, presence is to be alive. *Helene Victoria Lindquist 2015*



ABSTRACT

Background and aim: Many female cancer survivors who suffer from the consequences of secondary lymphedema experience physical, physiological and social limitations. Many studies have been made of some elements of self-care in the management of lymphedema but there are few if any studies of all of the potential elements that self-care might consist of. Therefore the overall aim of this study was to identify and then explore as many of the different elements of self-care as possible that are applicable in dealing with secondary lymphedema in female cancer survivors.

Methods: In study I, a cohort of women (n=786) treated with radiotherapy after gynecological cancer treatment answered a study-specific questionnaire. In study II women (n=8) were interviewed about self-care. Study III was a cross-sectional study (n=83) and the women answered a study-specific questionnaire. The same women were included in study IV, a clinical controlled intervention (n=88). The women answered a lymphedema study-specific questionnaire and a questionnaire on daily function. The women were also measured for the outcome limb volume, joint movement and BMI.

Results: In study I, overall quality of life was significantly lower among women with LLL, with a RR 1.4, 95 % CI 1.2-1.7. The women reported that LLL had a negative impact on several daily activities. In study II self-care as practiced by these women consisted of elements that were physical, physiological and social. The emerging themes were: Acceptance, Recovery, Physical activity, Manageability, Obstacles, Social self-care, Manual self-treatment and Ergonomics. In study III, women with low well-being (OR= 4.5, CI 1.7-11.7) not accepting their body (OR= 3.9, CI 1.0-15.3) and ethnicities other than Swedish (OR= 5.3, CI 1.1-25.6) were observed to engage less in self-care of their lymphedema. Not accepting lymphedema was a risk to think that self-care did not help (OR= 5.9, CI 1.6-22.4). Sleep quality and self-care were correlated ($r = 0.2$, $p = 0.04$). In study IV, there was a higher percent of women who participated in water exercise and who thus reduced their arm limb volume ($p=0.029$), BMI ($p=0.047$) and self-reported swelling ($p= 0.031$). Women in land exercise improved their DASH scores ($p=0.047$) and outer rotation in the shoulder ($p= 0.001$).

Conclusions: Lower Limb Lymphedema has a negative impact on quality of life, affects sleep and daily life activities, yet few women seek professional help. Self-care involves physical, psychological and social aspects and acceptance may have an influence on if and how the women do self-care. Almost 60 % of the women performed self-care every day despite the fact that 50 % of them reported that self-care did not help. Furthermore, at risk of not taking care of themselves with self-care were women with low well-being, women who reported difficulties in accepting their body and women with ethnicity other than Swedish. We found that a greater percent of women decreased their secondary lymphedema volume, BMI and frequency of swelling after engaging in water exercise than in land exercise. In the land group, improvements were shown in daily shoulder function, and in outer rotation of the shoulder.

Implications: It is important to actively ask patients at risk for lower limb lymphedema about early signs of lymphedema and then help them to get early treatment .We could do more to empower the patients to see the good things within themselves and have an open dialogue about obstacles, frustration and guilt about not doing enough in the field of self-care. Social support can increase the patients' self-esteem. Low well-being, negative body-image and ethnicity other than Swedish can be factors worth registering in medical records so they can be taken into consideration in helping vulnerable individuals adjust to self-care. Water-based exercise can be appropriate treatment influencing and improving limb volume and BMI. Land-based exercise can be appropriate treatment resulting in improved shoulder function in these patients. Adequate evidence-based programs are needed.

LIST OF SCIENTIFIC PAPERS

This thesis is based on the following papers, referred to in the test by their Roman numerals.

I. Dunberger G**, Lindquist H,** Waldenström AC, Nyberg T, Steineck G, Åvall-Lundqvist E. **"**Lower leg lymphedema in gynecological cancer survivors-effect of daily life functioning" *Support Care Cancer* 2013; 21: 3063-3070

II. **Lindquist H,** Enblom A, Bergmark K. "Self-care among female cancer survivors with secondary lymphedema- a qualitative study" *Rehabilitation Oncology* 2015; 33: 51-57

III. **Lindquist H,** Dunberger G, Enblom A, Nyberg T, Bergmark K. "Frequency and predictors for performance of self-care in female cancer survivors with secondary lymphedema" Manuscript

IV. **Lindquist H,** Enblom A, Dunberger G, Nyberg T, Bergmark K**. "**Water exercise compared to land exercise and standard care in female cancer survivors with secondary lymphedema" *Lymphology* Accepted for publication

CONTENTS

LIST OF ABBREVIATIONS

CDT	Complex Decongestive Therapy
LLL	Lower Limb Lymphedema
BCRL	Breast Cancer Related Lymphedema
ALND	Axillary Lymph Node Dissection
BMI	Body Mass Index
US	United States

1 INTRODUCTION

Physiotherapists working with cancer patients almost always start by assessing what the patient can do herself that will help her reach a state of better well-being and function in her daily life. Personal treatment is the basis for my ideas and hypotheses used in developing my research. Aaron Antonovsky has described two ways of viewing patients. He asks if the question to be asked at the beginning should be "What can't she do?" or should it be "What can she?" He describes the first as the pathogenic perspective and the second as the salutogenic perspective[1-4].

My experience in 30 years of meeting patients in oncological rehabilitation has deepened my compassion for my patients and my interest in supporting patients to keep their faith in themselves and to become empowered to deal with the new and overwhelming situation created by a cancer diagnosis and further the diagnosis of lymphedema. One way to support the patients is to learn more of their own experiences and develop treatment options that are grounded in the patient's own activity and ability. My other profession as a health-care teacher has also forced me to try to develop information, instructions, education and especially the learning dialogue between us and the patients to help them to become empowered and develop the personal integrity and self-efficacy needed to deal with the suffering of having secondary lymphedema. Secondary lymphedema is a double burden. At first they have a cancer diagnosis. The lymphedema is furthermore often a reminder of the cancer which can worsen the suffering even more. My goal in doing the research that underlies this thesis was to create a foundation for giving hope and direction for the women to see that they can do things for themselves to change and relieve the suffering from lymphedema. Of course the treatment given by health-care providers is important, but the most important must in my view always be the strength and possibilities that patients have inside themselves and in their own direct activities. It should be remembered that self-care should never be a burden that can lead them to developing thoughts of guilt and blame for not doing the best and enough. We shall be there for them but also support them to be as strong as they can possibly be. As a doctoral candidate, I have learned to structure my ideas, hypotheses and develop methodologies for research needed to reach some of the goals set for female cancer survivors with secondary lymphedema. The time as a doctoral candidate has been creative, inspiriting and made me become a more stringent researcher from the best of schools.

2 BACKGROUND

2.1 THREE STEPS TO OPTIMAL HEALTH IN CHRONIC DISEASE

Treatment for secondary lymphedema most often has its focus in treatment given by health-care providers. The context for the research leading to this thesis is the female cancer survivors' own active treatment, usually referred to as "self-care". The goal of self-care is to use all that the woman can do herself to prevent progression of the swelling and to strengthen her self-efficacy and well-being. All humans who suffer from chronic diseases may follow three steps to reach

optimal health (Figure 1). The first step is to get control over the disease, here lymphedema, and to see to it that it does not progress by using CDT (combined decongestive therapy) [5-7]or in early stages just instruction in self-care[8-10]. The second step depends on the woman's ability to take care of herself with self-care between visits to the health-care provider. The third step is about life style changes such as losing weight, engaging in physical activity and finding a balance between activity and rest. The research for this thesis had its approach in the last two steps in this program. The women's own active role in influencing health and well-being is important for them to reach integrity, optimal function, and human development in a very often bewildering life situation.

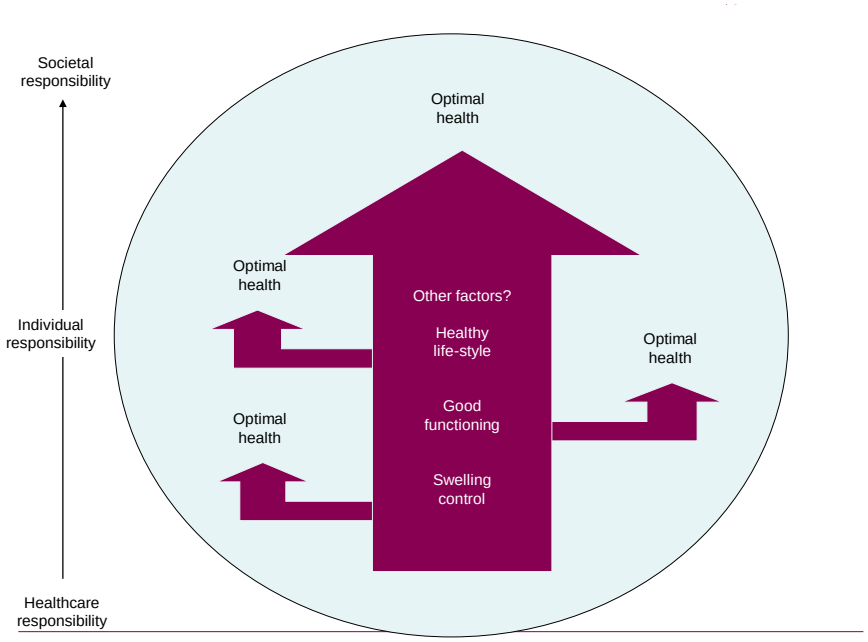


Figure 1.Three steps to optimal health Ref: Christina Opavas theory for chronic diseases

2.2 CANCER REHABILITATION

The purpose of cancer rehabilitation is to prevent and reduce physical, physiological, social and existential effects of the disease and the treatment. The rehabilitation efforts should give the patient and his/her relatives support and preconditions to live as good a life as possible[11]

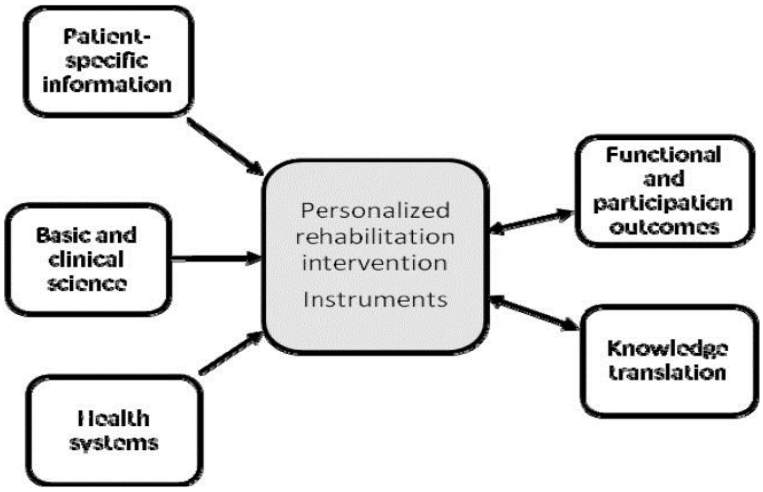


Figure 2. Cancer rehabilitation research framework (McEwan et al 2013)

Personal and *individualized* actions should be a core goal in cancer rehabilitation. Important factors include age, gender, cancer type, co morbidities, physical context, social context, and psychological borders, economic issues and personal values. Basic and clinical science has to include response to interventions in all above contexts. The elements of the health-care system have to coordinate their interventions both individually and through group interventions. Interventional outcomes and knowledge translation have to be monitored to judge the effects. The bidirectional arrows show the importance of continuously developing and testing the ongoing interventions. We must always strive to adjust the cancer rehabilitation program to meet the needs of the individual as shown below (Figure 3) from the Swedish National Health Care program for cancer rehabilitation

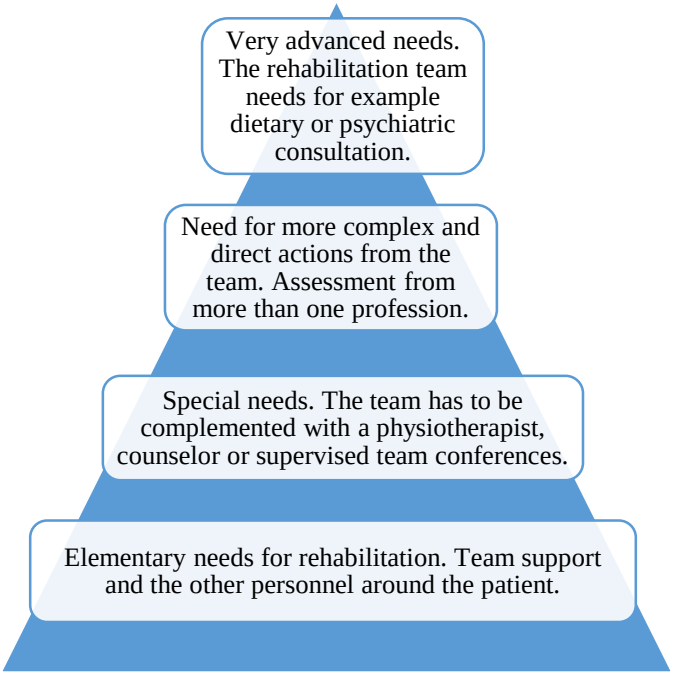


Figure 3. Patients individual needs on different levels of health care

Rehabilitation has become an integral part of clinical care of survivors after cancer treatment both for the treatment of motor problems and for health related quality of life . Exercise intervention is fundamental in improving the motor and psychological sequelae during the post treatment rehabilitation period. A multidiciplinary educational treatment is effective in improving functional abilities and wellbeing[12]. Patients' needs for supportive care including healthy lifestyle programs are high. Fortunately, cancer survivors generally have a positive attitude towards self-management and health. Need and attitude can be associated with sociodemographic and clinical variables and quality of life. A tailored approach is needed to provide innovative care for breast cancer survivors[13]. The care and education for the patients should include a supporting component. It is important to provide resources that address psychological and psychosocial needs. Supportive educative programs will play a pivotal role in the quality of survivorship[14].

2.3 BREAST CANCER AND LYMPHEDEMA

Breast cancer constitutes approximately 30 % of all female cancer[15]. Mammography, early detection and more advanced treatment have contributed to increased survival rates. The five year survival rate is now 89 % in Europe[16]. Following diagnosis and treatment for breast cancer, long term survivorship requires continuous adjustment to physical and physiological challenges, including surgery and treatment of side effects such as lymphedema[17]. Lymphedema is one of the most common complications of breast cancer and has a negative impact on the survivor's quality of life[18-20]. The incidence is approximately 20 %[21,22], with an increased risk with axillary dissection and radiation[22-24]. The self-reported incidence is up to 49 %[25,26]. Risk factors for developing lymphedema after breast cancer are large tumor size, more than 11 lymph nodes removed, BMI greater than 25, and breast cancer surgery plus radiation[23,27-30]. Ostby et al also point out additional risk factors including sedentary lifestyle, post-surgical infection, radiation skin reaction, age, genetic predisposition, and medication use and co morbid conditions[31]. Lymphedema can entail severe complications in the arm and shoulder, leading to limitations in many activities that are part of daily life that can remain many years after treatment[25]. Patients treated with ALND (axillary lymph node dissection) require special attention in order to detect impairments such as pain, and decreased strength and joint movement[32,33]. Lower functional scores can be associated with fear of lymphedema, more pain, BMI >25, mastectomy and having axillary node dissection[34]. Many breast cancer patients also suffer from overweight or obesity and could be helped by physical activity both for their general health and positive influence on the lymphedema[35,36]. Body image has been found to be altered not only after surgical treatments, but also after radiation and chemotherapy and must be taken into consideration by clinicians[37]. Concern with body image, attractiveness, and femininity have also been found to be correlated with depression in breast-cancer patients, impacting negatively on quality of life among women with breast cancer[38,39]. Women treated for breast cancer can also be helped by acceptance and positive reappraisal due to cognitive catastrophizing, rumination, and self-blame[40].

2.4 GYNECOLOGICAL CANCER AND LYMPHEDEMA

Globally, gynecological cancer accounts for 17%% of all female cancers[41]. The reported incidence of LLL (Lower Leg Lymphedema) in these patients varies between 7 and 78 %[28,42-44] with the highest incidence in patients treated both with surgery with radiation, even if surgery is the primary cause[45,46 28,42,47,48]. The large range in reported incidence may be attributable to difficulties in establishing a strict definition of lymphedema, potential reporting bias, and differences in follow-up-time[49]. Endometrial cancer is the most common malignancy of the female genital tract. The women have a good prognosis with five year survival rate > 85%[50]. Lymphedema is experienced by about 12 % of endometrial cancer patients and the incidence is 30-41 % for women who had 15 or more lymph nodes removed[50,51].

Cervical cancer is the third most prevalent cancer[52]. Early-stage cervical cancer is treated with pelvic lymph node dissection, combined with radical hysterectomy. Lymphedema is a possible long-term complication following the surgery, occurring in between 4 and 41%, and is also a possible complication after robot-assisted laparoscopy occurring in 26%[53]. Although vulvar cancer is rare it has profound effects on these women's quality of life[54]. The most frequent symptom causing lower quality of life in these survivors is lymphedema. The incidence of leg lymphedema after lymphadenectomy in vulvar cancer is up to 85 %[55-57]. Treatment-related effects, including urinary, gastrointestinal, sexual, and neurologic side effects, disrupting long-term quality of life are common in women with gynecological cancer especially cervical cancer[58-65]. Health care has an important role in developing psychosocial encounters to influence functional quality of life for women with gynecological malignancies, and there is also an important role for health care givers to prevent progression of lower limb lymphedema with detection of early signs and symptoms[66,67] though early symptoms are easily overlooked by physicians[68].

2.5 LYMPHEDEMA

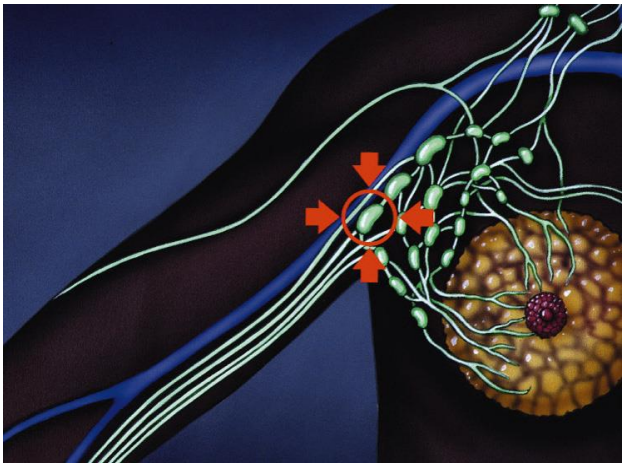


Figure 4. The lymphatic drainage from the arm to the axilla, the arrows point to the first lymph node reached by the lymph fluid, the "sentinel node" used as the target in the sentinel node surgical procedure[69].

Lymphedema occurs when the lymphatic load exceeds the transport capacity. There are two general classifications of lymphedema: primary and secondary. Primary lymphedema is a consequence of pathologic congenital or hereditary etiology. Secondary lymphedema is caused by mechanical insufficiency due to surgery, trauma, infection or tumor blockage[70,71]. Although lymphedema usually affects one or more of the limbs, its effects can be manifested in areas located around the swollen part such as the breast, thorax, abdomen and genitals depending on whether the lymphedema is progressing in the upper or lower extremities. Diagnosis begins by taking a standard history and by noting clinical presentation. Tests such as lymphoscintigraphy and Magnetic Resonance Imaging (MRI) may be used to confirm the presence of impaired lymphatic fluid[72] . Lymphatic vessels normally function to remove the net fluid efflux from capillaries that accumulates in the interstitium, thus maintaining steady interstitial pressure. Venous capillaries reabsorb 90 % of the fluid in the interstitium, while the remaining fluid is transported to the blood as lymph. Under normal conditions, the same amount is transported to the interstitium as is transported from it, a balance which is disrupted in lymphedema due to reduced lymph-transport capacity, thus leading to a fluid accumulation and swelling[71] .

Figure 5 shows a basic description of the lymph fluid through the interstitium. Badkar = Bathtub, säkerhetsventil = security valve or outlet.

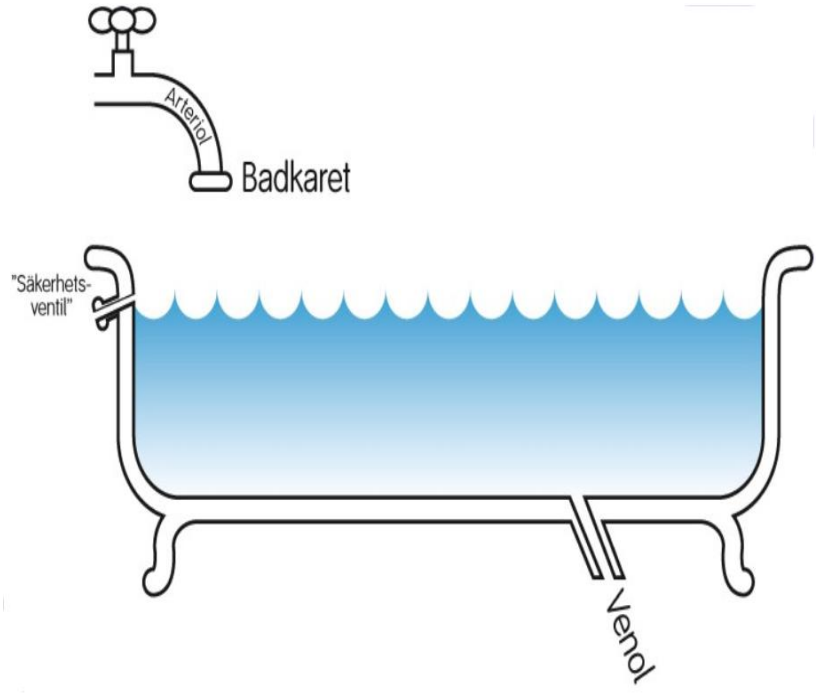


Figure 5. The lymphatic fluid in the interstitium

Left untreated lymphdema can progress in several states[73]. There are three stages distinguished in the basis of severity[72,74], from soft pitting edema, with complete resolution of prolonged elevation to elephantiasis with hyperkeratosis, fibrotic tissue[75,76], and skin infections, demanding high rates of treatment with CDT (Complex Decongestive Therapy)[5,7,77,78]. CDT combined with long-term self-management is efficacious in treating patients with lymphedema

of the extremities[79]. Ostby et al describe an additional stage, resulting in four stages from I-IV[31]. I= a subclinical stage where swelling is not seen despite underlying changes in the lymphatic system. I - Patients can perceive symptoms as swelling. Stage I can be confirmed if elevation alleviates the swelling. II= swelling is constant and pitting without resolution using elevation. III= the tissue has become hard and fibrotic with associated skin changes. Based on volume difference between affected and contra lateral limb, lymphedema can also be rated in severity; Mild<20% increase; Moderate= 20-38% increase; Severe= > 38 % increase[31]. It can be an advantage to even include a stage 0[74], because of the importance of early detection of lymphedema and the fact that self-perceived lymphedema has as high score as objective lymphedema in long-term follow up[80].

First-line treatment for lymphedema is compression (i.e., static garments, pneumatic compression, and bandaging, figure 6 and 7). Compression reduces extremity volume and minimizes progression by 1) decreasing the amount of fluid escaping from the venous system, 2) improving proximal lymph flow by transporting lymphatic drainage into lymphatic-venous anastomoses, and 3) slowing adipose deposition that results from high-protein fluid in the interstitium[81]. The most common treatment to prevent lymphedema progression is CDT (complex decongestive therapy)[5]. Between CDT treatments the patient must follow a prescribed plan that spells out what she must do to retain the results of the treatment and to hinder any worsening of the lymphedema [14,82,83]. Liposuction and controlled compression can be an option for severe lymphedema[84]. The treatment of lymphedema must be individualized, taking the patient's personal experiences of the condition and psychosocial situation into account[85] and patients own perception has to be incorporated[86].

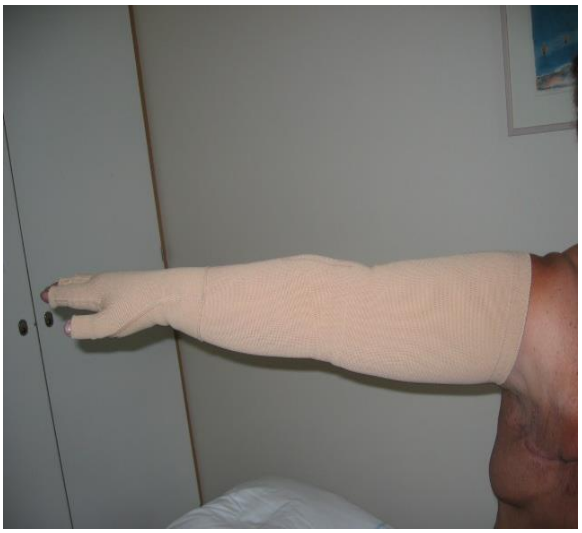


Figure 6. Woman with secondary lymphedema after breast cancer treatment, wearing compression garmet and glove.

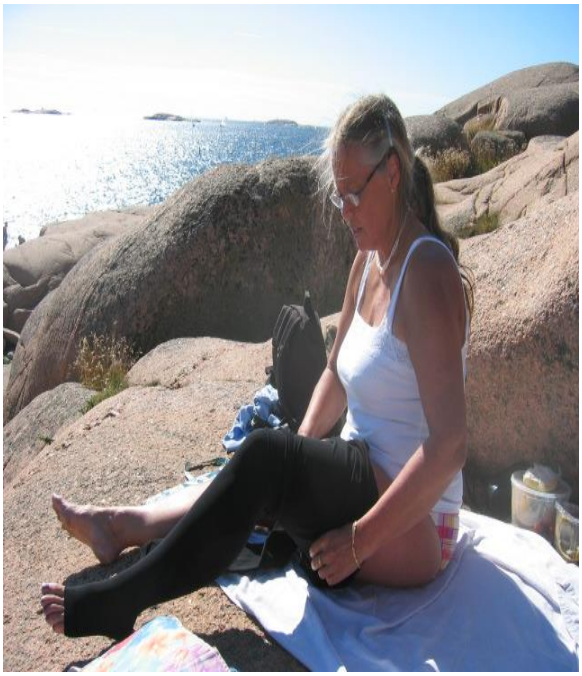


Figure 7. Woman with bilateral secondary lymphedema. "Taking on the compression hosieries after sunbath".

2.6 FEMALE CANCER SURVIVORS WITH SECONDARY LYMPHEDEMA

Secondary lymphedema after breast and gynecological cancer treatment is in most cases a chronically progressive condition characterized by the pooling of protein-rich fluid and sometimes adipose tissue in the extremity[21,28]. For the women it is a series of severe symptoms affecting them, symptoms such as severe swelling, skin infections, pain and heaviness, negative body-image, decreased mobility and strength, all of which often lead to a decrease in daily function and lower [20].

Identifying the early signs and symptoms is a challenge for clinicians, but is important since the earlier the diagnosis the better the chances of preventing progression of the lymphedema. It should be recommended that patients receive guidance as soon as possible that can lead them to follow routines that can restrict worsening of the symptoms [83]. Some studies have found that patients report that health care workers seem not to have sufficient knowledge of lymphedema and therefore fail to guide patients from an early stage of the disease. Although we know a lot about the impact of lymphedema for the female survivors, little attention has been paid to potential psychosocial consequences[87]. In essence the women have to be experts on their own condition and cope as best that they can[88].

Barlow et al recommend that clinicians must listen more carefully to the women who are fighting with adjustment to this diagnosis and the influence the symptoms have on their daily life[88,89]. Women who feel that they are not getting help and support and even recognition of the

fact that they are no longer able to easily do the things that they want can then fail to engage in self-care.

Patients at risk for edema ought to be prepared for the possibility that they can be afflicted. I knew nothing myself. If I had been put into contact with an edema therapist at an early stage, had gotten treatment and had worked on my own self-treatment it would never have needed to became as terrible as it did become (Woman, 45 years old).

During the summer it can be unbearably painful when it is hot, so really I do not enjoy the summers now. I used to be a sunbather and I loved to go swimming, it is easier to live with my leg when it is not so hot (Woman, 65 years old).

*I have to get my husband to sort of do things because I don't have enough strength, whether it's sunscreen lids, or opening a box. I get very frustrated I can't do what I want I used to be able to do because I don't have the strength now (*Woman, 54 years old*).*

I have had a "year off" from my lymphedema the latest year. Have not had any contact with rehab clinics. I am very tired of the whole thing and do not do anything to improve the lymphedema except for avoiding what is bad. I am alone and have two kids and a dog (Woman, 47 years old).

2.7 DAILY FUNCTIONING

The daily experience of having lymphedema can lead to decreased function with negative impact on well-being and increased distress[46,90].

The concept of daily functioning can be assessed in different areas, such as body functions, body structures, activities and participation and also in personal and environmental terms (International Classification of Function-ICF). One study described the use of the ICF test as a basis for development for the lymphedema sufferers. The study showed that lymphedema patients reported limitations in activity due to impaired body functioning and also reported anatomical changes that influenced their daily life. The environment can be both a facilitator and a barrier for patient functioning[91]. Daily functioning and how we as physiotherapists can understand and support the patients is shown in figure 8. Patients who have the physical and mental abilities for daily function do not need more support than preventive education. The most complex scenarios are when the patient lacks motivation and at the same time does not have the physical abilities for daily functioning.

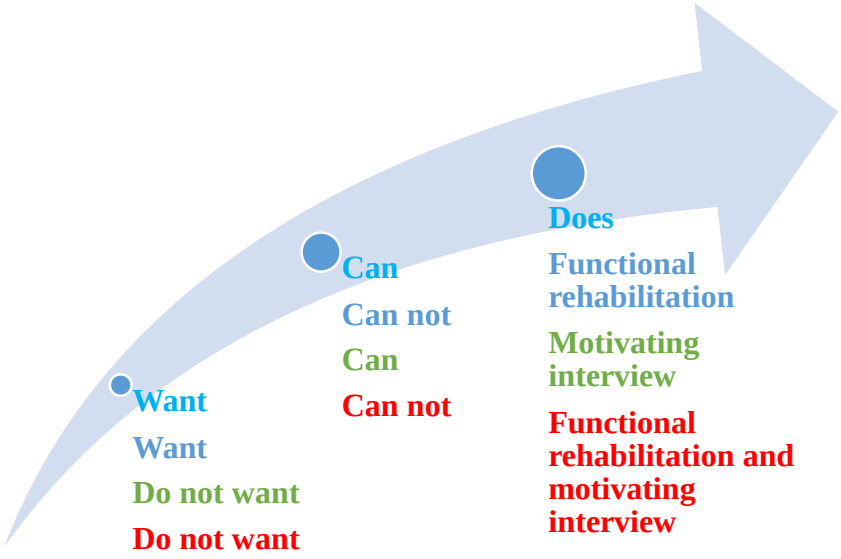


Figure 8. Understanding of rehabilitative support (H. Lindquist 2015)

2.8 SELF-CARE

Self-care is described by Orem as: *An activity of maturing persons who develop the ability to take care of themselves in their environmental situations. It is the practice of activities that individuals initiate and do for their own behalf in maintaining health and well-being. When performed effectively, it contributes to human and structural integrity, human functioning and human development*[8,92].

Self-care is a central concept in health care, and may be regarded as the means through which a patient can maintain, restore, and improve health and well-being. The practice of self-care can also be expanded as a concept and fundamental goal for individuals to reach for a high extent of self-care agency[93].

To reach transition from one stage to another can be facilitated by self-care activities, a transition that entails a complex mix of personal-environmental interaction. In health care we as professionals deal with humans anticipating transition, experiencing transition or completing the act of transition[94]. Söderhamn et al has claimed that there is a dialectical relation between self-care ability and the potential for self-care activity itself. Factors influencing self-care ability are goal direction, perception, motives, means for problem solving, means for cooperation and support and means for reconciliation[95]. A closely related concept is self-management. There is no gold standard definition of self-management[10]. Clark et al suggest that the difference between the concepts is that self-care is more preventive than self-management and that self-management is more related to interventions often in groups led by health care professionals[96]. Self-management has also been described as a preventive behavior in secondary lymphedema[97].

Overall adherence to management increased over time. Adherence to use gloves was lower than all other behaviors. Over time knowledge, self-efficacy and self-regulation increased and distress decreased[98].

Self-care is believed to be able to alleviate the lymphedema and maintain results of CDT [14]. Special exercises to increase physical activity, preventive teaching about the risks of getting/ worsening the lymphedema and education in self-care activities can decrease the progress of the lymphedema[24,83,99,100]. There are sometimes frustrating challenges for the women, both physiological and social, to deal with during self-care, and the fear of whether or not they are able to handle the situation to hold back the progressive disease with self-care[101]. Symptom stress and self-management can be a burden for the women which can lead to anxiety, depression, emotional stress, affected sexuality and feelings of sadness[102]. Complexity of introducing self-management also directly influences the women's family, nearest friends[14,82] and well-being,[103] . Self-efficacy and self-regulating factors can be important in the situation dealing with self-care[98]. Another study by Brown et al, point out that self-care in BCRL was not related to limb volume and self-reported symptoms in 12-month follow-up[104]. There is no consensus about the concept of lymphedema self-care, but we now have research showing that self-care and self-management could lead us to look at this definition as something more than physical treatment that the patients do on their own[88]. We ought to widen the concept to include social and psychological aspects.

To understand all the underlying factors influencing self-care we could ask the women what self-care means to them. We also could dig deeper into what factors actually influence how and if the women perform self-care. Figure 9 shows a possible psycho-social pilot model and overview of self-care. The women can confront problems and obstacles from their personal chart and how they perceive the consequences and the efforts of self-care in their daily life. Emotional stability and how the women deal with obstacles also influences the personal way to reach self-care. Feelings of guilt, blame, and "catastrophe thinking" can affect them negatively. Confidence for their body, and if they are able to accept the new situation may influence how they put up limitations to protect themselves. To reach self-care individuals also need social support both from health care but also from the nearest relations.

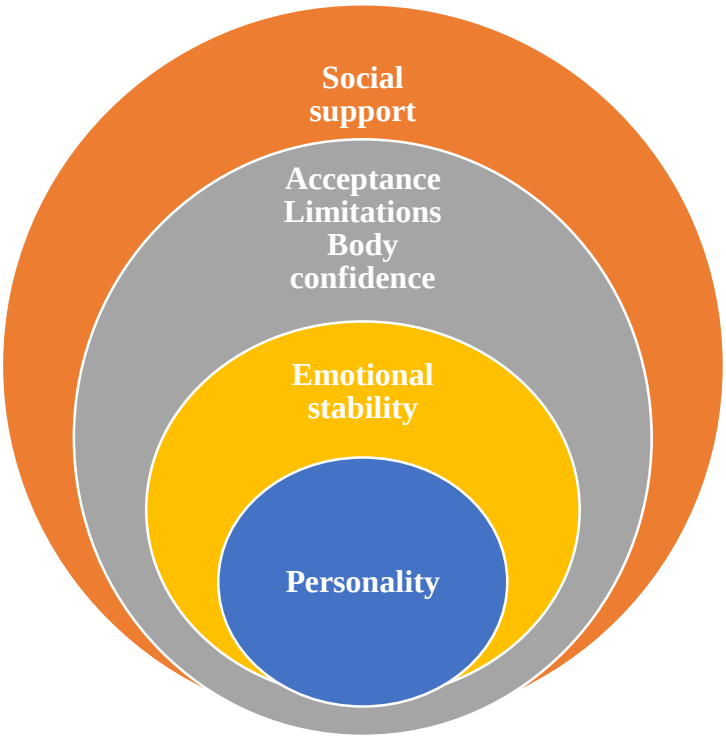


Figure 9. Concentric circles of possible influences of self-care ability. A pilot theory (H. Lindquist 2015).

2.9 PHYSICAL EXERCISE

Physical exercise may prevent the development of breast cancer related lymphedema[105,106]. We know from the latest studies on land-based strength training, water exercise and pole walking, that exercise does not worsen the condition[105,107-112]. We also know that supervised strength training has benefits for increasing strength and milder arm symptoms[31] and body-image can be positively influenced[113]. Katz et al reported that weight lifting can be a trigger for erysipelas in LLL[114]. However, none or very little knowledge exists regarding whether physical exercise can improve outcomes such as limb volume, BMI and daily function. There is also a distinction between physical activity and physical exercise to be remembered. These conceptions are often mixed with each other in literature. Physical exercise is something planned, structured and with a goal to improve or maintain physical condition, muscle strength and endurance[115]. Physical activity has been proposed as an effective non-pharmacologic intervention to promote psychological wellbeing during and following cancer treatment[116]. A growing body of evidence indicates that physical activity improves muscle strength and body composition in people with cancer. Perhaps the most essential principles of training are individualization, progressive overload, and rest/recovery. A brief overview of each of these principles is provided in figure 10[117]. Exercise prescriptions are most often operationalized using the

following parameters: Frequency (session per week), Intensity (how hard per session), Time (session duration) and Type (modality) or F.I.T.T[117].

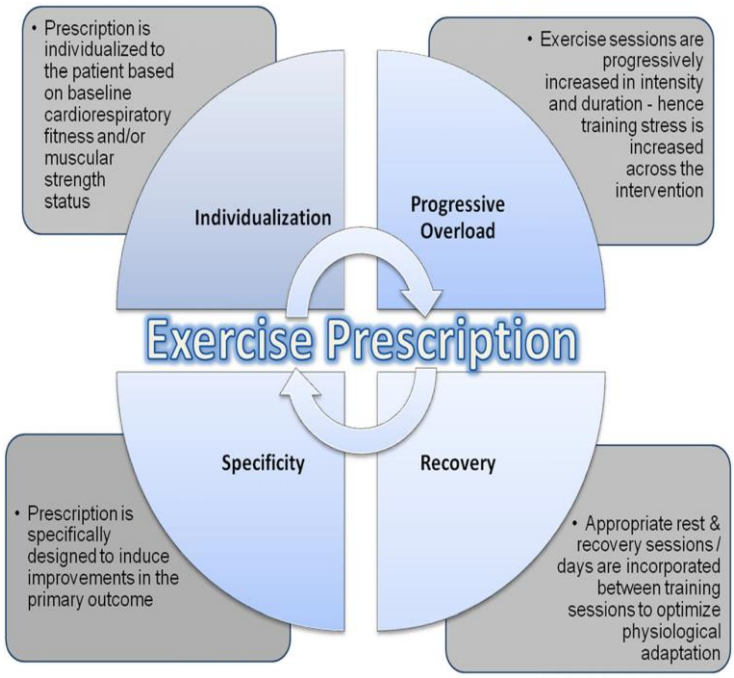


Figure 10. Overview of exercise principles

2.10 WATER EXERCISE

Water immersion decreases axial loading and, through the effects of buoyancy, allows performance of movement that may be impossible to do on land. Water exercise has the extra ordinary abilities to influence buoyancy, resistance, flow and turbulence compared to land exercise.

The water hydrostatic pressure[118] can also be compared with the compression sleeves or hosiery's used as the most evidence based treatment of lymphedema for influencing limb volume[119]. One can hypothesize that hydrostatic pressure could be one of the effects of water exercise in secondary lymphedema together with the depth in water and use of the dynamic hold-relax of the muscles under this conditions.

It has been shown that water based exercise improves breast symptoms and is feasible to help lymphedema patients in increasing joint movement[109,120] and not worsening the lymphedema. Another form of self-massage and slow movements under water has shown improvements on limb volume directly after a session. However, this method cannot be compared with physical exercise under water[121].

3 AIMS

The overall aim of the research leading to this thesis was to explore and increase knowledge regarding experiences, predictors and results of self-care by female cancer survivors with secondary lymphedema.

The specific aims were as follows:

1. To investigate well-being and daily function in gynecological cancer survivors
2. To describe female survivors experience of self-care due to having lymphedema.
3. To identify frequency and explore factors predicting of performance of self-care
4. To investigate and compare water exercise with land exercise and standard care

4 METHODS

	Study I	**Study II**	**Study III**	**Study IV**
Design	Cohort	Qualitative	Cross-sectional	Clinical controlled intervention
Study group	A cohort in gynecological survivors undergoing radiotherapy (n= 786)	A fenomenographical approach in women with secondary lymphedema (n=8)	A consecutive sample of females with secondary lymphedema (n= 83)	A consecutive sample of females with secondary lymphedema, included in water exercise, land exercise or standard care (n= 88)
Inclusion criteria	Gynecological cancer survivors treated with external radiotherapy, born 1927 or later	Female cancer survivors with secondary lymphedema	Diagnosed secondary lymphedema of the arm after breast cancer or in the leg after gynecological cancer irrespective of duration since diagnosis, and ability to speak and understand Swedish	Diagnosed secondary lymphedema of the arm after breast cancer or in the leg after gynecological cancer irrespective of duration since diagnosis, and ability to speak and understand Swedish
Exclusion criteria	Recurrence of malignancy	Active cancer disease, not able to understand Swedish	Ongoing intensive CDT (Complex Decongestive Therapy), recurrence of cancer, ongoing active oncological treatment, or disabilities of such severity hindering them to participate in exercise programs	Ongoing intensive CDT, recurrence of cancer, ongoing active oncological treatment, or disabilities of such severity hindering them to participate in exercise programs

Table 1. Overview of the designs, populations and study criterion

4.1 STUDY POPULATION

4.1.1 Paper I

A cohort of 1,800 women treated between 1991-2003 with external pelvic radiation therapy for a gynecological malignancy at Radiumhemmet, Karolinska University hospital in Stockholm and Jubileumskliniken, Sahlgrenska University hospital in Gothenburg was invited to participate. In total 789 patients remained and were eligible for the study. The Swedish Population Registry delivered names and addresses for 478 control women to be compared with the cancer survivors.

A study specific questionnaire was used[19,122-124]. Based on qualitative interviews a study-specific questionnaire was constructed. The questionnaire consisted of 351 questions concerning physical symptoms faced by gynecological cancer survivors after cancer treatment. The questionnaire also included questions on psychological issues, quality of life, social functioning and sexuality. In total 19 questions were concerned specifically with lower-limb swelling and treatment for this condition. For example: "Have you had swelling in your legs during the past six months?", with the possible answers "No", "Yes, occasionally", "Yes, at least once a month", "Yes, at least once a week", "Yes, at least three times a week", and "Yes, at least once a day". We were interested in examining how gynecological cancer survivors with lower leg lymphedema reported daily life functioning and well-being. Among the survivors all women received radiation therapy and 90% surgery.[62,125].

The main study was carried out in 2006 and the participation rate was 78% among survivors and 72% for control women. The method used has previously been described by Dunberger et al [58].

4.1.2 Paper II

In paper II the patient's own active part in the treatment for lymphedema and earlier studies about the importance of the patients own lymphedema care were our ground question.

To reach understanding of the concept of self-care from the female survivors opinions, and construct a base for developing a study specific questionnaire in-depth interviews with women with secondary lymphedema (n=8) were performed using a qualitative phenomenographical approach.

4.1.3 Paper III-IV

In total, 109 female cancer survivors with secondary lymphedema were recruited from two hospitals and one primary health care unit in central, eastern and northern Sweden. The women were consecutively invited by a physiotherapist with special education in lymphedema treatment at each clinic, or recruited through advertisements in patient organization papers. Survivors were eligible for inclusion if they had been diagnosed as having either breast or gynecological cancer. Participating women had to be able to speak and understand Swedish.

Exclusion criteria were ongoing intensive CDT, recurrence of cancer, ongoing oncological treatment or functional disorders hindering participation in exercise programs (this last criterion was not used for participants recruited to standard care).

4.2 QUALITATIVE PHASE

4.2.1 In depth interviews

Female survivors with secondary lymphedema were interviewed. Patients who had attended the Lymphedema School in a primary health care unit in Stockholm in the preceding two years were consecutively asked to participate (n = 21). The physiotherapist asking the patients for participation also gave them an information letter about the study and the patient's anonymity rights and the possibility to end their attendance if needed. Ten women agreed to take part in the study. Two dropped out because of illness. In total eight interviews were conducted. Each interview lasted in 1,5-2 hours and was tape-recorded and transcribed verbatim. The women had had lymphedema from one up to 12 years when the interviews took place in 2009, and they were 45 to 71 years old. Three women had lymphedema in their legs and five women in an arm. The interviews started with an initial question that was followed up with more structured questions if needed.

First open-ended question:

- Can you tell me what self-care means for you?

Follow-up questions:

- What do self-care and self-treatment mean for you, do you see them as being the same thing?
- Do you think that there are obstacles to your being able to carry out your own self-care?
- Do you think that there were episodes or phases when you felt better as concerning your lymphedema?
- Do you have ideas about how you might treat yourself?

4.2.2 Theoretical framework

A phenomenographical approach was chosen in order to determine qualitatively the different ways in the participants' perception of the phenomenon[126,127]. Phenomenography was developed by Ference Marton and co-workers in the 1970s, based on research findings in the area of learning within higher education, and has gained widespread acceptance in the fields of health care and nursing research. The intention of the interviewer is to focus on the phenomenon as experienced by the interviewee and to court a welcoming and open dialogue where the interviewee can be herself as much as possible. The overall aim in phenomenography is to investigate both similarities and differences in the way we experience and understand

phenomena in the world around us. The phenomenographical approach emphasizes the collective meaning more than the individual's experience[128]. Phenomenography distinguishes between the actual states of something and how it is perceived and the essence of phenomenography is how something is conceived to be. This means that a distinction is made between the first-order perspective, which starts with facts that can be observed, and the second-order perspective, which starts with the individual's experience of something, or how something appears to be[129]. The main question and the structured following questions are based on facts in health care, the so called first-order perspective, and the interviewees experience is the second-order perspective. The interviews take place iteratively in an iterative phase between these perspectives [129].The explorative nature of data collection generally follows a series of recommended analytic steps. In our study we chose Dahlberg and Fallsberg's seven steps[129].

4.2.3 Data analysis

The analysis was done independently by two of the authors, HL and AE, and the analyses were then discussed iteratively until agreement could be reached on a single analysis. The analysis was done until the gold standard of saturation in the analysis of each theme was reached, when several respondents had the same understanding concerning one and the same thing, and no new information appeared[127]. The analyzers had different backgrounds used to reach validity and to help them come to an inter-subjective agreement[129].

For the analysis we used Dahlgren and Fallsberg's theory [129] in seven steps (familiarization, condensation, and comparison, grouping, articulating, labeling and contrasting) in analyzing the transcripts. In the first step, *familiarization,* we read the material carefully several times and the tapes were listened to on repeated occasions. After that, *condensation,* we chose the most significant perceptions describing the phenomenon self-care. Also different perceptions were chosen. The perceptions were named and listed in the margin of the protocol. Much time was devoted to the phase of really getting to know the material. In the next step, *comparison,* we compared the perceptions with one another, in order to identify differences between them and logical relationships to each other. The differences and similarities, *grouping,* between the interviews and each individual interview were subsequently compared. The perceptions were grouped into preliminary categories. The groupings were repeated several times. A preliminary description, *articulating,* of the essence of the different preliminary categories was made to describe the similarities and the differences. In this step subcategories took form in detail. A linguistic expression was denoted, *labeling,* for each of the categories and subcategories. In the last step we compared all categories, *contrasting,* and their unique character was described, as well as similarities to the other categories.

4.2.4 Questionnaire

Based on clinical experience, interviews and existing literature, we constructed a study specific questionnaire following practices established in the Division of Clinical Cancer Epidemiology[19,122-124] (figure 11) .The questionnaire comprises 108 questions and includes questions about demographics, symptoms, co-morbidity, treatment, self-care, well-being, body-image and information on health care.

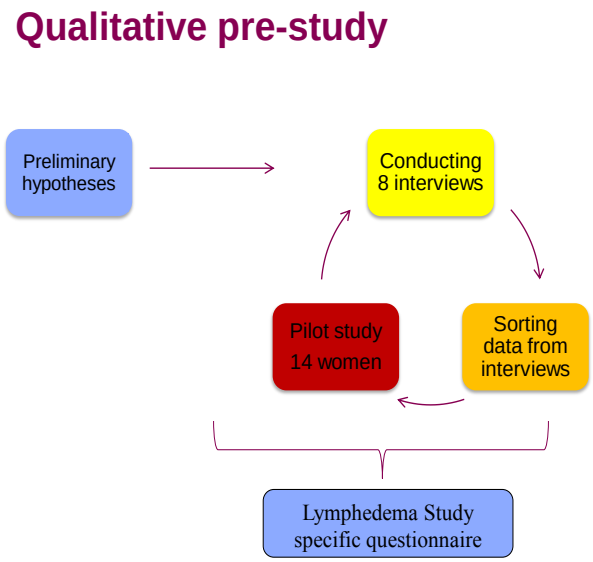


Figure 11. Epidemiological method used for developing the study spesfic questionnaire

4.2.5 Face-to-face validity

In this phase we wanted to examine if the 108 questions were understood by the female cancer survivors. Therefore, we invited 12 women with secondary lymphedema to validate the questionnaire. We went through the entire questionnaire, first individually and afterwards in a group discussion. We discussed how the questions were perceived and made an effort to be sure that they had understood the answering categories in each question. After the group session some questions were rewritten and some questions were also added based on the women's opinions and the research group's discussions. A new version of the questionnaire was constructed.

4.2.6 Pilot study

In the next phase we performed a pilot study using 14 women where the new version was tested. We further developed the questions in detail and then the final version was ready to use in the quantitative studies.

4.3 QUANTITATIVE PHASES

4.3.1 Data collection

Data were collected between January 2012 and January 2013. Women with secondary lymphedema were consecutively asked to participate in the main study. The physiotherapists asked the patients if they wanted to sign an information letter to confirm that a researcher could call them and give them more information and a letter of consent to be signed if they wished to participate.

Of the 109 women invited to participate, 88 were eligible for participation. The selection was adjusted to make the groups as demographically equal as possible. Participation rate was over 80%.

The baseline data from the study specific questionnaire were analyzed for frequency and predictors in self-care. Data were collected using subjective and objective measurements described below. The cancer survivors were given a questionnaire along with a pre-paid envelope, which was to be posted to the study evaluator. To maintain anonymity, each participant was given a number for identification. All participants signed an informed consent form.

The 88 women were invited to meet three specialists in lymphedema treatment (depending on geographical location) to be measured and to fill in the study specific questionnaire.

The survivors were divided into three groups depending on where they lived. They were treated in three treatment groups:

A. The water exercise group included 35 women who participated in 10 weeks of group intervention once a week, led by a physiotherapist. The water exercise training was a standard program with the aim of increasing aerobic capacity, strength and mobility. It was carried out in a 25 meter indoor pool, with 140 cm water depth at a water temperature of 28-29° C. The 50 minute program included the following components: warm-up exercises for 10 minutes, mobility and stretch exercises for 10 minutes, movements to increase the pulse for 10 minutes, strength training for 10 minutes, and slow-down mobility exercises for 10 minutes. At the end we added hold/relax exercises for the muscles around the swollen limb and deep breathing in the slower parts. All women wore compression sleeves/hosiery during the exercises. If a woman participated seven times or more, she was defined as having complied with the intervention.

B. The land exercise group comprising 29 women participated in gymnastics in groups on land; 10 weeks of intervention once a week. The program included the same components as the water exercise. The only difference was that the leader adjusted the training for the women who could not jump, so that they could instead perform exercises near the floor. The same routines for compression and compliance were used.
C. The standard-care group included 24 women receiving standard care, i.e. self-care consisting of skin-care, mobility exercises for the arm or leg, placing the swollen limb above heart level, doing self massage of the arm and leg, using compression sleeves/hosiery and occasionally employing manual lymph drainage.

4.3.2 Measurements

The women were measured approximately 1-1, 5 weeks before and after the intervention.

4.3.3 Limb swelling

Three physiotherapists measured the primary outcome of lymphedema volume in milliliters (ml) using either the water-displacement method or the measurement of circumference method, depending on which method was established at that clinic (Figure 12). Both methods are reliable and valid[130,131] and well correlated with a coefficient of correlation of 0.813-0.915[130]. The participants graded their self-perceived frequency of limb swelling by answering the question: “How often are you swollen in your arm/leg?” graded 1-6, where 1 was never and 6 where they were swollen every day or almost every day. The values were recorded in individual charts.

Figure 12. Lymphedema limb volume with water displacement method.

4.3.4 Body Mass Index

The participants reported their height and weight before and after intervention. BMI was then calculated (weight [kilograms] / (length [meter]) ^{2}).

4.3.5 Joint movement

The physiotherapists measured active joint movement with goniometry according to usual standards in physiotherapy [132], and a clinical possible measurement error of 4-5 degrees for intra reliability [133,134]. Active hip and knee flexion in the lower extremity, and active elevation-abduction, and lateral rotation in the shoulder joint were measured.

4.3.6 Daily physical function

The participants graded physical function for the upper extremity with DASH - Disability of Arm, Shoulder and Hand questionnaires. DASH provides a summary score on a 100-point scale, with 100 indicating the maximum level of disability. DASH is a valid and reliable function test for the upper extremities[135,136]. HOOS - Hip Osteoarthritis Outcome Score questionnaire - was used to measure function in the lower extremities. HOOS consists of questions on pain, function and range of motion. The HOOS score gives a maximum of 100 points, where a higher score means less dysfunction. The test has high reliability and validity[137,138].

4.3.7 Study-specific lymphedema questionnaire

The participants provided demographic, clinical, well-being and health data by answering questions in the 108 question questionnaire regarding their present situation (reference to page 24).

4.3.8 Well-being and body-image

The participants graded global well-being by answering the question: “How would you describe your well-being?” graded on a visual digital scale ranging from one to seven. To measure body-image, we used seven items from a validated body awareness verbal Likert scale [139].

The baseline data from the questionnaire were analyzed for frequency and predictors in self-care. Data were collected using subjective and objective measurements described below. The cancer survivors were given a questionnaire along with a pre-paid envelope by the study physiotherapist, which was posted to the study evaluator.

4.3.9 Performance of self-care

Four questions were asked concerning the outcome called “performance of self-care”: “How often do you do self-care at work?”; “How often do you do self-care at home?”; “Can you take care of your lymphedema in the way that you wish with self-care?”; “Do you think that the self-care helps?” The answer alternatives were: “Not at all”; “Little”; “Moderate”; or “Much”.

4.3.10 Socio-demographic and clinical characteristics

The cancer survivors were asked to provide the following information: age, date of debut of lymphedema, weight and height, educational level, ethnicity, and employment status. They were also asked if they had received instructions concerning self-care and about their confidence in health-care with replies ranging from "no" to "much". We also asked about the quality of their relationships with those who were near and not so near to them; answer alternatives were expressed on a seven step scale.

4.3.11 Individual characteristics

The questionnaire included questions about general well-being, physical condition, and acceptance of having lymphedema, depression, anxiety, sleep, body-image, self-esteem and coping with daily life.

4.3.12 Data entry

Transfer of data from the study for paper was performed using the freeware data and validation program EpiData 3.02.

Transfer of data from the studies for papers III and IV was performed using Microsoft Access 2010.

4.3.13 Statistical analyses

In the study for paper I, 98 % of the survivors answered the question "Have you had swelling in your legs during the past 6 months?" The symptoms were dichotomized into having had the symptom "at least occasionally" during the past 6 months or not having had the symptom. Differences in characteristics were investigated with *t*-test for continuous, and Fisher's exact test for categorical variables. The relative risk (risk ratios= RR), was calculated using log-linear regression. All tests were performed at the 5% significance level.

In the study for paper III we calculated descriptive statistics in terms of numbers (n) and proportions (%) of women answering each alternative, and mean values with standard deviation (SD), regarding continuous variables. We dichotomized the outcome variables regarding performance of self-care into two groups: "Do self-care at home" or "… at work" with women answering "A couple of times per week or less", or "Once per day or more". We did the same for the answers to questions asking if the women felt that "they could take care of their lymphedema" and if "self-care helped" using alternatives "no"/"little" or "moderate"/"much". To assess possible associations between characteristics and the above outcomes, we calculated odds ratios (OR) together with 95% confidence intervals (CI) between different sub-groups of women according to socio-demographic, clinical, individual, and functional characteristics, using logistic regression. For each possible predictor, the choice of reference group was done *a priori* based on which group we anticipated to be the strongest. To ensure that the variation of risk in different sub-groups was not related to variations in the possible confounding factor

edema volume, we also gave the corresponding odds ratios (OR) adjusted for volume of arm edema in the breast cancer survivors n= 38/69. Due to the small number of gynecological cancer survivors (n=14), this was not calculated for leg edemas.

We calculated Spearman's r correlation coefficients between the ordinal or continuous participant characteristics to assess trends towards higher (or lower) levels in the outcomes across all levels of the characteristics. We performed all tests two-sided at 5% significance level. The number of participants included after omitting missing values is presented for each calculation. All calculations were done with SAS (version 9.4, SAS Institute Inc., Cary, NC, USA).

In the study for paper IV we analyzed each category regarding demographic and clinical characteristics. For the continuous outcomes lymphedema volume, BMI and joint movement, mean differences between before and after the intervention were reported with 95% CI. To compare these continuous outcomes after the interventions with baseline values within each group, paired samples t-tests were used. To compare the mean change in-between the groups for these variables, a group by time interaction test from repeated-samples ANOVA was used. Ordinal categorical outcomes DASH and HOOS scores, body-image and well-being were shown with median and inter-quartile range. We compared DASH and HOOS scores at baseline and after the study-period within each group with the Wilcoxon's signed-rank test. Median change during the study period for these variables was compared in-between the groups with the Kruskal-Wallis test. The body-image and well-being outcomes after the study period were compared to the baseline outcomes using the sign test. For all outcomes, the number (n) and (%) of participants who had a decrease or increase (at least one step) in outcome ratings between the before and after measurements were presented, as well as those with no change (tied). For all outcomes, we used Fisher's exact test to compare the numbers that decreased or increased, excluding ties between the measurements.

Sample size calculation was performed according to the primary outcome lymphedema volume using the following approach: Given that data were collected from 160 exercising participants (water based and land based exercise) and that the spread in volume (standard deviation) was 220 ml for both groups, the study would have 80% power to detect a mean difference between water and land exercise groups of 101 ml (a clinically relevant difference) at 5% significance level. All calculations were done with SAS (version 9.4, SAS Institute Inc., Cary, NC, USA).

4.4 ETHICAL CONSIDERATIONS

There are always ethical issues and dilemmas in research. We need to protect our research participants from all kinds of inconvenience and harm. Many of the questions can be reminders of certain distressing situations. Questions can also be too personal and may threaten the women's integrity. Therefore, ethical principles should be followed with stringency including anonymity, informed consent, confidentiality, and respect for integrity.

In the studies all women were informed in detail about the study and the right to decline participation at any point without reprisal. The women were also informed that all data are stored in a secure unit with access only possible for the research group. All measuring status, formulas and questionnaires' were identified by a code and not related to their personal id.

A couple of situations can have been distressing for the women. The first is the interview situation. To talk about your deepest thoughts and emotions with an unfamiliar person demands a lot of courage and can be bewildering for some. Secondly the situation at the clinics when the women were physically measured could have been an inspirational situation for some who see that the lymphedema was under control, but on the other hand distressing for some women if the lymphedema was still in progression. It can also be uncomfortable to undress in front of an unfamiliar person and show a body you maybe are not so comfortable with. Third, to fill in a questionnaire with information about who you are, and what you do in your own behalf can be distressing and can remind some patients about areas they find it hard to think about.

The studies were reviewed and approved by the Local Ethical Committee in Stockholm (Dnr: 2010/784-31/3 and Dnr: 2005/1424-31/4)

5 RESULTS

5.1 PAPER I

5.1.1 Characteristics and treatment

Among the survivors 218/606 (36%) reported lower limb lymphedema. The women in this group with LLL were more likely to be receiving disability pension than those without LLL. Twenty-seven % of the women with BMI 30 or higher had LLL.

5.1.2 Physical symptoms

The women with LLL reported higher prevalence of fecal incontinence than women without LLL (RR= 1.2, 95 % CI 1.0-1.4). Those with LLL also had a higher prevalence of urinary urgency (RR= 1.6, 95 % CI 1.2-2.3) and urinary incontinence (RR= 1.3, 95 % CI 1.2-1.5) than those without LLL.

5.1.3 Quality of life and daily activities

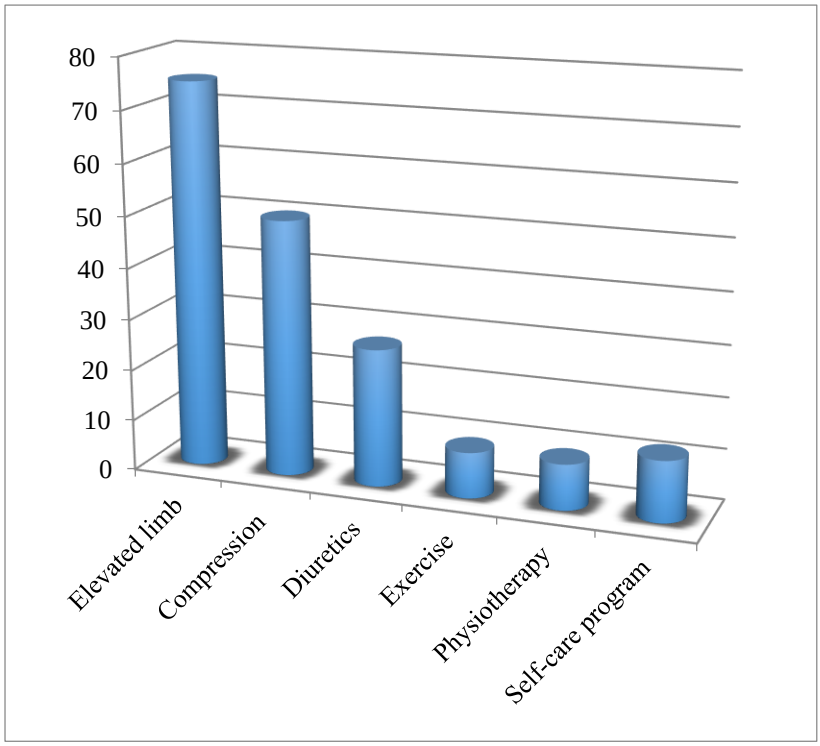


Figure 13. Self-perceived activities reducing lymphedema (% of total activities)

Overall quality of life was significantly lower among women with LLL than among those without, after adjusting for age, fecal incontinence, urinary urgency and urinary incontinence, with a RR of 1.4, 95 % CI 1.2-1.6. LLL women were less satisfied with their sleep, RR 1.3, 95 % CI 1.1-1.5, and they were more likely to interpret symptoms and signals from their bodies as indicating recurrence, RR 1.4, 95 % CI 1.2-1.7 (Table 1).

	Gynecological Cancer Survivors with Lower Limb Lymphedema N= 218 (%)	Gynecological Cancer Survivors *without* Lower Limb Lymphedema N=388 (%)	Adjusted* Relative Risk 95% Confidence Interval
Overall Quality of Life – ***low to moderate***	145/215 (67)	176/385 (46)	**1.4 (1.2-1.6)**
Satisfied with sleep – ***low to moderate***	153/213 (72)	193/381 (51)	**1.3 (1.0-1.5)**
Would have refrained from radiotherapy treatment if consequences known – ***yes***	33/209 (16)	49/373 (13)	1.1 (0.7-1.6)
Worries about recurrence of cancer - ***yes***	145/218 (67)	193/386 (50)	**1.3 (1.1-1.5)**
Interprets symptoms and signals from body as recurrence – ***yes***	123/218 (56)	141/384 (37)	**1.4 (1.2-1.7)**
Feeling attractive as a woman - ***not at all***	66/213 (31)	89/367 (24)	1.3 (1.0-1.7)
Satisfied with sexuality and present sexual life - ***not at all***	77/197(39)	95/327 (29)	1.1 (0.9-1.4)

Table 2. The survivors reported that LLL had a negative impact on several daily life activities.

5.2 PAPER II

5.2.1 In-depth interviews were performed with the women with lymphedema

Respondent	Age	Diagnosis	Time interval from treatment/trauma	Time for self-care per day*	Work situation
R1	49 years	Breast cancer	After 6 months	15 minutes	Assistant nurse
R2	57 years	Breast cancer	After 2 years	1 hour	Librarian
R3	55 years	Breast cancer	After 3 months	30 minutes per day	Secretary
R4	71 years	Gynecological cancer	After 12 years	2 hours	Retired
R5	53 years	Breast cancer	After 1 year	1-5 hours	Controller in a chemical company, computer work
R6	45 years	Melanoma in the leg	During the treatment	1-2 hours per week	Hairdresser
R7	50 years	Breast cancer	After 1 year	45 minutes per day	Administrator in a governmental department
R8	67 years	Trauma	Directly after trauma to her leg	1.5 hours per day	Retired

Table 3. Characteristics of the respondents

5.2.2 Eight themes emerged from the analysis

Acceptance was developed by getting a perspective of the women's experience of living with lymphedema.

During the past year I have learned to accept my arm and have begun to buy short sleeved shirts and blouses. Previously I did everything I could to hide the arm with long sleeved clothing in order to avoid all the curious looks and questions about what I had done to my arm. Mentally, it feels good now that I have come so far, that I do not worry about it any longer. It is as it is, best to just make the most of it, in other words take care of yourself and your arm (R2).

Recovery concerned both physical and mental recovery. The recovery could be both active and more passive.

The garden can help me very much. To go out and pluck some wilted flowers or just go out and look, I can do that. It is really, I feel that this is therapy for me (R6).

The participants experienced different types of physical activity as a part of self-care. All participants reported that they used compression stockings during the activity.

I feel my swollen fingers when I walk quite a bit, but when I walk with poles it is much better, when I actively use my arms as well, which is good (R4).

Manageability has to do with setting boundaries, guilt, frustration, and joy at seeing results.

If my legs feel lighter than my whole body feels lighter, then my body feels lighter and the leg lighter, but, yes, I do believe that one is happier and manages to do more (R1).

The women felt that it was of critical importance to have routines, and obstacles to routines could be related to both time and place. There are always obstacles to following a routine.

Perhaps more "help" at home. That it ought to be obvious that I also get time for myself without that resulting in having a bad conscience because I am thinking about myself (R4).

The women mentioned that spending social time with others in the same situation or with family and friends helped motivate them to engage in self-care.

I ask my husband to back me up and help me to say "no" and to prevent me from taking on something or doing something for someone else that I do not want myself – or something similar – when he notices that I am on my way to doing that (R6).

The women used different kind of manual methods to self-treat the lymphedema.

I: How did you use the bandage? *Above all at night and especially when I am working less. Because I become tired of the bandage. You maybe wake up five, six, seven times and fall asleep really late. But this makes you more tired during the day and you really need to rest sometime during the day. At the same time that you get a real benefit, this makes you more tired* (R7).

Ergonomic thinking can be relevant both in the home and at the work place, and can include taking a break, varying the work, working independently, and using different exercises and positions.

Partly at work, when I am sitting in front of the computer, I go out for a while. Now I have to go to the printer and that is good, print instead of saving a few jobs as I used to do earlier, now I go out for each, so I get to take short walks continuously. And I think about not carrying out repeated movements too long, but take breaks. And I feel that this is something that makes me feel good, both helping the lymphedema and in helping my psychological well-being (R6).

5.3 PAPER III

5.3.1 Characteristics

Of the 109 female cancer survivors screened for inclusion, 88 were included and 83 women delivered data. Mean age was 62 years, and 69 (83 %) of the women had arm lymphedema and 14 (17 %) leg lymphedema. Debut of the lymphedema ranged from < 1 year to > 10 years ago. The most common participant in this study was a Swedish born (83%) woman, with over-weight or obesity (73%). The women had moderate to high well-being (95%) (Table3).

5.3.2 Performance of self-care

Among the 83 women, 58 % performed self-care at home every day, 37 % did self-care a couple of times per week and 7 % never did self-care. Self-care at work was more seldom performed: 25 % never did self-care at work, 8 % performed self-care a couple of times per week, and 10 % did self-care every day. Approximately half of the study group was working.

Forty-three % of the women thought that self-care helped moderately to much and 48 % of the women thought that it helped just a little. Six % stated that it did not help at all. Forty-two % of the women stated that they could take care of themselves with self-care moderately to well, 44 % of the women thought that they could take care of themselves just a little. Fifteen % thought that they could not take care of themselves at all with self-care.

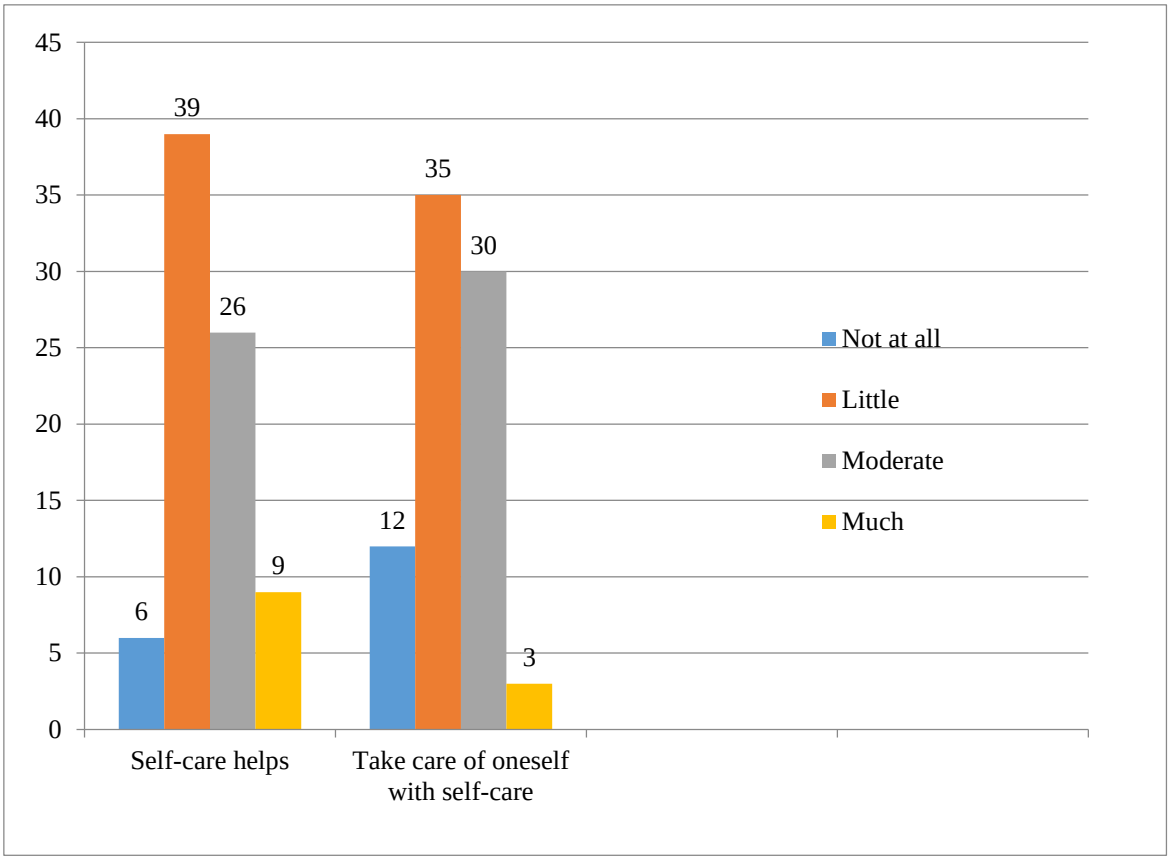


Figure 14. Self-perceived evaluation of self-care

5.3.3 Socio-demographic and clinical characteristics related to self-care

Women with an ethnicity other than Swedish had higher risk of not engaging in self-care (OR= 5.3) (p= 0.04).

5.3.4 Individual characteristics related to self-care

There was a higher risk that women with low to moderate well-being could not engage in self-care as well as women with high well-being (OR=4.5) (p= 0.002).

5.4 PAPER IV

Eighty-eight cancer survivors participated in the study (Figure 14). Of the 35 women in the water exercise group, 30 (86%) complied with ≥ 7 exercise sessions compared with 19 (66%) of the 29 women in the land exercise group, and were thus included in the analyses. Of the 15 women who were not included in the analyses, six in the land exercise group dropped out because the exercises were too strenuous and four dropped out because of not reaching the compliance level. In the water exercise group, four dropped out for no stated reasons and one because of an arm fracture not related to the exercise (Figure 14). There was almost full adherence to wearing compression garments during the interventions.

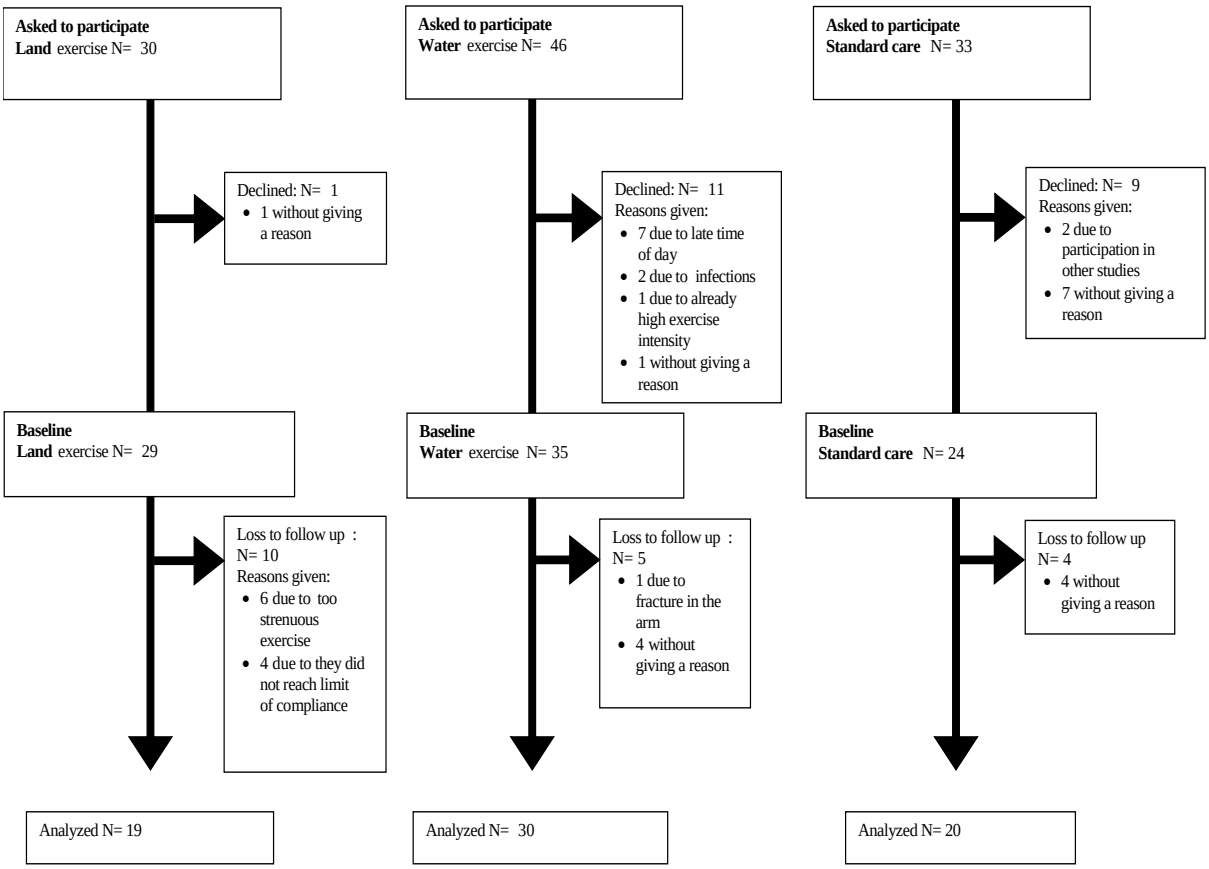


Figure 15. Flow-chart on the study

5.4.1 Characteristics related to limb volume in the study groups

The women in the water exercise group were somewhat younger than the women in the land exercise and standard care groups, and were also professionally active to a higher extent than women in the other groups. A high proportion of the women in all groups were overweight or obese at baseline. Limb volume increased with age. Elementary school only and ethnicity other than Swedish (n=14) also appeared to be related to larger limb volumes.

5.4.2 Clinical data and earlier treatment related to limb volume

At baseline, the mean volume difference between the sick and healthy limb was 277 ml in women with arm lymphedema (n=41) and 1057 ml in women with leg lymphedema (n=8). On average, approximately eight years had passed since the women in all three groups had been treated for cancer. The start of lymphedema or swelling developed within one year of treatment in most of the women, but the time since diagnosis was wide ranging from under one year up to over 10 years, with no differences between the groups. There was a higher prevalence of a history of erysipelas in the land exercise compared to the water exercise group and compared to the standard care group. Compression therapy was less common in the standard care group than in the two intervention groups (75%, versus 97% and 93% respectively). Previous manual

lymph drainage was most common in the standard care group and most frequently was still being performed in this group (48%, versus 11% and 7%, respectively). Receiving previous instructions concerning self-care was more common in the women in the land exercise group than in the other groups. Larger limb volume was seen in women who had had erysipelas and who had hypertension. Women who had been treated with diuretics and hypertensive medication had larger edemas.

5.4.3 Reductions in limb volume, swelling, and BMI

A higher proportion of the women in the water exercise group than women in the land exercise group had reduced their arm lymphedema volume (p=0.029). There was no statistically significant difference in *the size* of the reduction of limb volume between the groups after, intervention. The arm lymphedema women in the water exercise group had reduced their lymphedema volume (p=0.046) (Figure 2), a result not seen in the other groups. In the leg lymphedema women, no differences in limb volume in the groups were observed after intervention (Table 3). In the water exercise group, the women reported a lower frequency of limb swelling after the intervention (p=0.031), while neither the land exercise group nor the standard care group reported a decrease (Table 4). There was a significant reduction in BMI (p=0.047) in the water exercise group after intervention, but not in the other groups. The *size* of BMI reduction did not differ statistically significantly between the groups after the intervention (p=0.812) (Table 3).

5.4.4 Joint movement and increased physical function

After the intervention with land exercise, the women experienced improved outer rotation in the shoulder (p=0.001). Elevation in the shoulder was decreased statistically significantly but was not clinically significant. There were no other improvements in joint movement in or between the groups After the intervention, the women with arm lymphedema in the land exercise group had improved DASH scores (p=0.049).There were no changes in DASH scores in the other two groups after the interventions. Among the leg lymphedema survivors, neither the proportion improving joint movement or HOOS scores, nor the *size* of the improvements were found to differ between the groups at the end of the study period (Table 3).

5.4.5 Changes in well-being and body image

Overall well-being was high at baseline in all three groups, and stayed at these levels during the study period without statistically significant differences between the groups.

6 DISCUSSIONS

6.1 INTERNAL VALIDITY

Internal validity refers to the reliability of accuracy of the study results. It reflects the authors confidence that study design, implementation and data analysis have minimized or eliminated bias and that findings are representative of the true association between exposure and outcome.

To come as close to the truth as possible in research outcomes, we have to use our clinical intuition, research experience and models to exclude bias in all steps of the research process.

There are no studies without errors. The development of randomization, sham treatment and triple blinding are means that can ensure data, but still we stand in front of possible bias in our studies. These instruments for increasing quality of data are not reachable in every study for practical, ethical or other reasons.

In epidemiological research the hierarchical step-model has been developed and used in many studies as a possible means to reach the best possible quality in studies. The steps in the model are described below and are shown in Figure 14.

The model starts with the perfect person time, the wish scenario, in the best of worlds. In the studies of this thesis this was applicable to all women with secondary lymphedema. During the transition to the next step, targeted person time (all women with secondary lymphedema in middle and north of Sweden) confounders or factors can prevent or cause the outcome of exposure. We identified many confounding factors when first formulating the research plans, among them age, exercise habits, and BMI. The criterion for ascertaining whether a factor really is a confounder is that 1) the factor is one of the factors that cause the outcome (limb volume) 2) the factor is associated with a causal factor (water exercise) and is *not* a part of the causal chain (not to be mixed with mediating factors). In order to minimize confounding we use randomization, placebos, matching and restriction and also making sure that the study groups are followed for the same time period. In intervention studies, it is also important to have equal wash out periods in the intervention groups to decrease the risk of a factor other than the causal factor influencing the outcome measure. Unfortunately, we could not use randomization in our studies for practical and geographical reasons, so we had to be careful with finding information about confounders to adjust for them later on in the analysis if needed. In between the selected person time (step 3) and the observed person time (step 4) bias in the form of misrepresentation can occur. Once we have identified the participants in the group to be observed it can be a challenge to actually get them to stay in the study during the entire study period. High drop-out rates occur when all too many candidates decline participation or when participants simply drop out. So the result is that we lack information from the ideal number of participants during the observed target time. And if we are unlucky, it is possible that drop outs could be just those who had the outcome which supports our hypothesis.

The way to minimize misrepresentation is to plan the studies with precision, and if possible conduct a pilot study. If a questionnaire is to be used, then face to face interaction with a subset of the subjects to ensure that they understand the questions can help to validate the questionnaire and even refine after a pilot study. This practice can decrease the risk of bias that arises if questions are not answered because they are not understood or are too complicated to be answered simply. We can also increase follow up after sending the questionnaire either by telephone or with a letter.

In order to avoid a high level of misrepresentation we took the time to plan and structure the study in detail as well as possible given the sometimes complex nature of intervention studies. Before developing the study specific questionnaire we tried out each question in face to face meetings with subjects and also performed a pilot study.

The risk for the subject to be affected by any contact with the interviewer was small due to the fact that most of the survivors filled out their questionnaires at home. In contrast, remembering bias could have been a risk because the study group included women treated for their lymphedema between one and 12 years earlier so many might find it difficult to answer all demographic and treatment questions with 100 % accuracy. The remembering bias could have been even stronger than we suspected, because we did not compare the statements by the subjects with the data in their medical records.

The fifth step occurs in the transition from collecting information to our database. In this step misclassification is common both as concerns sensitivity and specificity. Neither of them can reach the 100 % level.

One type of misclassification is non-differential exposure. The error is equally large in the comparison groups. The effect measure is unchanged or diluted toward 1.0. This can lead to underestimation of the effect measure. One example can be that questions are not adequately answered.

The other type of misclassification comprises differential outcomes when the errors differ between the comparison groups. It can end with an effect measured in either direction when in reality there is none. This could damage the validity markedly. Ways of preventing differential faults are planning the study carefully, using validated research tools and if possible randomizing and blinding.

So, once the data have been collected we apply statistical tests to analyze our data and collect results and conclusions together, seeing the data in part on the basis of our clinical intuition and experience.

Error in the analytical phase can appear if for example the wrong statistical method is used for continuous or categorical data. The wrong reference category can also be a fault in this phase.

Even if our statistical methods are the best they do not give us the causality itself. We have to add our patho-physiological knowledge to a discussion in an effort to reach a final consensus about our effect measure and eventually effect modifiers.

With this hierarchical step-model[140] a more obvious picture of faults and errors in the research process is given (figure 16)

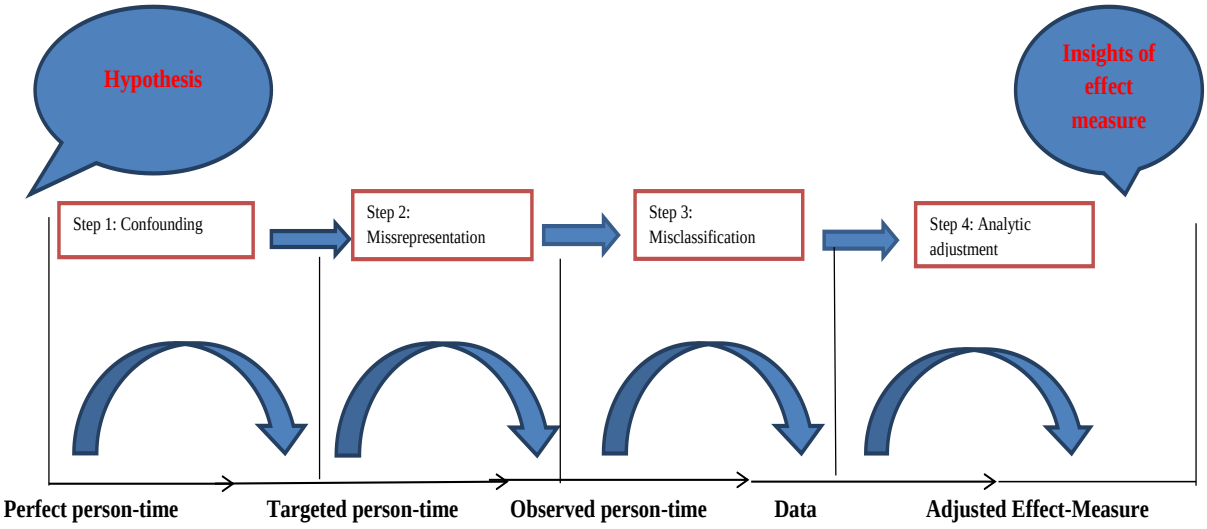


Figure 16. Hierarchical step-model

6.2 EXTERNAL VALIDITY

External validity deals with the degree to which findings can be generalized to other groups of the population. An ideal trial design would randomize patients and blind those collecting and analyzing data (high internal validity), while keeping exclusion criteria to a minimum, thus creating studying populations that are as closely related as possible, and allowing generalization of the results (high external validity). The external validity in this thesis has been discussed throughout the research process. The studies exclude men, so we do not know if these results are applicable to both genders. The studies are also carried out under Swedish conditions and therefore cannot be directly compared to the situation for women with secondary lymphedema

in other parts of the world. Comparisons may not be advisable due to different operation and treatment techniques, as well as other nationwide health care programs for secondary lymphedema. Patients or more precisely women with primary lymphedema in other countries cannot be directly compared with the women in our studies. However many of the results from studies outside of Sweden can be useful and comparable with our results and studies.

6.3 PAPER I

Cancer survivors with symptoms resulting from treatment of the cancer discover that being cured of cancer does not necessarily mean being in completely good health. As confirmed in our study, lower limb lymphedema jeopardizes the quality of life and daily functioning of gynecological cancer survivors. Even though lymphedema is not a life-threatening condition, it may not only cause suffering if untreated but also cause worry if undiagnosed. Giving patients appropriate and timely information about late effects and repeating this information during treatment may help to prevent physical and psychological suffering, especially since lymphedema may be mistaken by survivors as a recurrence of the original cancer or even a new cancer. Equally important is providing education about lymphedema and its management in order to protect legs, abdomen and genital tract from infection or trauma[58]. Concomitant symptoms such as urinary and fecal incontinence were more prevalent among the gynecological cancer survivors with LLL than among those without LLL. To our knowledge, this is the first study to report on these concomitant symptoms among gynecological cancer survivors with LLL. One of the risk factors for lymphedema is BMI higher than 30 and a decreased physical health condition[60]. In our study, a larger proportion of cancer survivors with LLL, reported BMI higher than 30 a result in line with other studies of cancer survivors with LLL[60]. Early symptoms of lymphedema are ambiguous and easily overlooked by physicians [141] and other health-care professionals. If LLL progresses it may cause pain, decreased muscle strength, increased susceptibility to infection[42]. A vast majority, more than 70 %, of the gynecological cancer survivors in our study with LLL also reported low to moderate satisfaction with sleep. Insufficient quality and quantity of sleep are associated with physical and psychological disorders [68]. We can only speculate about the reason for this insomnia among the survivors with LLL. We have not found many reports of research on lower limb lymphedema and quality of life after gynecological cancer treatment. However, Beesley and coworkers studied 802 gynecological cancer survivors, using a self-report validated questionnaire based on earlier qualitative findings. They used a set of questions to determine lymphedema status and to capture the experience of having LLL[60]. They found the levels of unmet needs to be considerably higher among the women with LLL compared with women with no LLL[142]. Among the highest ranked needs was that the women "needed help with fear of cancer spreading"[142]. The fear of cancer spreading was also observed among a significant proportion of the women in our study. We believe that for women living with a fear of recurrence, any new physical symptoms are easily interpreted as recurrence of cancer.

Among the strengths of the study for paper I is the method used, using a validated instrument developed in close cooperation with gynaecological cancer survivors, which we believe has had a great impact. In addition, the questionnaire was completed in the privacy of the respondent's home and in confidence; this may lower the risk of potential interviewer-induced bias. The fact that the research team was independent from the clinic may further decrease the risk of bias.

A limitation with paper I is the lack information about the non-participants. Furthermore, we lack information from survivors older than 80 years. In previous studies our research team has experienced individuals older than 80 years of age have a tendency to decline participation. For this reason we did not include women over 80 and consequently we cannot extrapolate our findings to the very elderly cancer survivors. Finally, the studies were carried out in Sweden and we do not know to what extent our findings are applicable to other populations and cultures outside Sweden.

6.4 PAPER II

Phenomenography has long been the method used for pedagogic research. We think that the concept of self-care is closely related to education and pedagogical areas, and this was therefore one of the reasons to choose this method. The other reason for choosing this method was to reach as many different opinions as possible from the participants to really catch what self-care means for the women with secondary lymphedema. Since a researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, we included two analyzers to perform the analysis[127]. We did not set up any preliminary hypothesis for this study because the purpose was to get women to describe their experience unaffected by anything we might have said. In this study we chose a relatively homogeneous group of women who had attended the Lymphedema School. They were, however, of different ages and some had lymphedema in the legs and some had lymphedema in an arm. The selection was based on the idea that this is a follow-up of previous studies of the Lymphedema School, and the women's deepened knowledge about self-care could have given us results based on women with great understanding of the conception of self-care taught in the Lymphedema School. The women were consecutively asked to participate in the study so the sampling was not biased by self-choice. The interviewer focused on creating an interview situation in a friendly and welcoming manner, where the participants could feel relaxed and comfortable which may have influenced the women to be more open and give deeper content to the interviews. The prior understanding of lymphedema in the research group has been used to further deepen the analysis and affects the validity of the results positively. We think that the long interviews (1. 5 hour in average), reached saturation and that the open question "What does self-care mean to you?" followed with more structured questions caught the essential aspects of the phenomena self-care in women with lymphedema. The study's validity is positively influenced by the condition that the interviews were recorded and transcribed very carefully and analyzed according to a qualitative approach[127] and the "7 steps theory" by Dahlberg & Fallsberg[129].

Our study showed that acceptance when faced with the illness and the resulting changes in appearance affected the way that the women thought about their self-care.

Acceptance as a preparation for being able to live with lymphedema has been described by Fu et al [87]. Several earlier studies also show the negative effects of concern with body image and appearance that lymphedema patients can have[20,143] and several of the women in our study described how they chose to hide or reveal their lymphedema to others. Our study showed that acceptance when faced with the illness and the resulting changes in appearance affected the way that the women thought about their self-care.

The need for recovery in self-care was both physical and mental. It is not clear if the exhaustion that is described in connection with lymphedema is an element of the general concept of fatigue and the cancer diagnosis, or if fatigue comes from the strain of the lymphedema in and of itself. One can imagine that knowledge and understanding at the workplace and access to a room where one can rest might be an important part of thinking about ergonomics in relation to living with lymphedema. Fifteen years ago we told patients with lymphedema not to overstrain and do too much physical activity because of the risk of worsening the lymphedema. Today we know that weight lifting[108,144] and pole walking[145] do not increase the volume of the lymphedema.

We were somewhat surprised when we saw the degree of physical activity that the participants displayed. Perhaps they had been so well trained that they practiced such a high level of physical activity, or else this is a societal phenomenon. Whatever the answer, it is good for lymphedema patients to maintain their weight by exercising since it is known that lymphedema is worsened by a high BMI[146]. Information about the importance of weight loss and avoiding weight gain can be emphasized in conversations with the patient, and the fact that recognition of the importance of weight loss comes from the patients themselves may also strengthen the patients' motivation. The patients were able to experience good feelings about the results and see the healthy rather than the unhealthy aspects, and also to be able to set boundaries to what they could manage in their daily life. They also had the experience of feeling guilty if they did not do this "in the right way", of feeling frustration and ambivalence about the swelling and the compression stocking, and of realizing that the lack of time prevented them from carrying out self-care. This has also been described by other authors[20,147]. Another way to manage the lymphedema was to run away from the problem; you do not need to think about something that does not exist. This may be a form of coping, i.e. to think emotionally or through a more problem based approach. Johansson has reported these strategies among patients with breast cancer related lymphedema[147]. Ryan et al[44] described in their study how patients with lymphedema in a leg following treatment for gynecological cancer could exhibit a positive coping with the condition, adapting to the situation while others felt that dealing with the lymphedema was worse than the diagnosis of cancer. Motivational interviewing[83] could be one way to strengthen the patients in believing in themselves and their own capacity to manage self-treatment. "Self-management", the term that is used regularly in the English language literature

on studies of patients' attitudes, recurs in this study as a specific theme, so we therefore may conclude that manageability is an important part of self-care.

6.5 PAPER III

The women's well-being seems to be a factor to be considered when we instruct and follow up the women doing self-care. Well-being is well described in studies as a factor influencing female cancer survivors experience with having lymphedema[89] and engaging in self-care[46], this study that directly influences the women's performance of self-care. Low well-being maybe hide a turnaround causality where we do not know if it is the low well-being that leads to not doing self-care, or if not doing or feeling that self-care helps is what leads to low well-being. Depression and anxiety were also correlated with the women not being able to take care of their lymphedema, which is in accordance with other studies [14].

Body-image and acceptance of the body seem to be additional factors to take into consideration when we work with women with secondary lymphedema. Teo et al have reported that body-image is influenced by and related to depressive symptoms in patients with lymphedema [103] and they also observed that negative body-image directly influenced how and if the women performed self-care.

Furthermore we do not have any consensus about the nature of self-care world-wide. The most commonly described elements are use of compression sleeves, exercise (but not what kind), bandaging, skin care, holding the arm or leg high, being careful not to damage the swollen limb, and not lifting heavy things [98]. Health-care providers must discuss self-care from a broader perspective than simple concern with the physical exercises the patients perform.

From a clinician's view, one can see the need to consider ergonomics and to avoid static muscle work. Patients' statements and notes in their medical records also tell us that patients themselves see a need to consider ergonomic factors, thus providing support for the clinicians' views.

But what would also be useful to provide much more recent information for patients about exercise; many studies made since earlier recommendations were formulated show that exercise such as strength training does not risk worsening the lymphedema as was previously believed [22,105,108]. Given that knowledge, we can be more thoughtful as concerns advising women to not lift heavy objects. Instead we perhaps ought to have a discussion with them about taking pauses, considering ergonomics, using compression and acknowledging their own signals about how the body and the edemas react in situations such as the lifting of a heavy object. The stepped model of care could be a strategy to use to identify women in need of more coaching. The approach focuses on providing in the first step basic help for all and then stepwise providing progressive interventions for the patients as determined by health-care personnel – the shared goal, to get the patients to establish their own self-care strategies[148-150]. One later step in the step-model could be support groups for the female cancer survivors. Advantages with support

groups have been described earlier as for women with ovarian cancer. The participants could share experience both emotional and intellectual, as well as support each other emotionally[151].

In our study, women with ethnicities other than Swedish were at risk of not performing self-care. From the clinician's point of view one can suspect that this can be related to difficulties with Swedish and with difficulty in understanding information and instructions even if an interpreter is used. Though the participants in the study could understand Swedish helpfully, we could speculate in the risk for women with larger difficulties to speak Swedish. Few studies have described the influence of ethnicity in lymphedema sufferers, although Schmitz et al have highlighted possible relations between ethnicity, obesity and lymphedema in cancer survivors in the US[152]; we do not know if those findings apply in Sweden.

Our findings concerning the correlation and increased risk of low self-esteem and not being able to take care of the lymphedema are in line with findings from other studies about the relation between self-care and emotional distress [14]. One can reflect over if the women's low self-esteem is associated with the burden of having lymphedema or with feeling that self-care helps. Quality of sleep and physical condition were correlated with not being able to take care of the lymphedema as well. Low quality of sleep and its relation to quality of life have been described by us in female cancer survivors with lower limb lymphedema[46]. We also know from earlier studies that both quantity and quality of sleep are associated with physical and psychological disorders, and swelling, pain, and the uncomfortable limb most likely has a negative impact on sleep. Dahl et al studied sleep in breast cancer survivors and concluded that pain was the strongest factor for insomnia[153].

Not accepting the diagnosis of lymphedema and the experience of not having been informed about self-care seems to place women at risk for thinking that self-care does not help. We have previously reported that women with secondary lymphedema experienced acceptance of their lymphedema as a factor influencing self-care [154]. Among the strengths of the study for this report is the method of using a validated instrument that was methodically developed in close cooperation with female cancer survivors with secondary lymphedema, which we believe contributed positively to the validity and reliability of the results [19,122,124]. The women answered the questionnaires in their home environment which lowered the risk of interviewer-induced bias. The study also had less than 15 % loss to follow up which strengthens the results.

Even though our study has several strengths, it still has limitations that need to be mentioned. The study was carried out in Sweden so we do not know if the results especially as concerns ethnicity are applicable to other cultures and populations outside Sweden. In the analysis of the possible predictors for self-care we adjusted for arm volume. Small changes were made in adjusted compared to unadjusted outcomes for "acceptance of having lymphoedema" and "information in self-care". One may explain the selection after adjustment, which was smaller because of that the leg lymphedema patients were not included and limb volume was not measured in all of the women.

6.6 PAPER IV

Limb volume was measured with either circumference or water displacement depending on local facilities. We think this had at most only a small risk of influencing the primary outcome since the methods are well correlated[130].

The number of women with leg lymphedema in the study was too small for us to be able to draw conclusions, and the HOOS function questionnaire is not fully applicable to this kind of lymphedema sufferers. The questionnaire includes many questions on symptoms at the hip, and the participants did believe the questions would apply to them. Future intervention studies including studies of physical function in the lower extremities might well use some other function questionnaire designed for women with leg lymphedema. However, DASH was well suited for the arm lymphedema patients in this study. In the study we developed a new study-specific questionnaire focusing on the specific aspects of lymphedema and exercise, function, well-being and body-image in lymphedema patients. This questionnaire is based on the patients' own experiences, extensive literature searches and the authors' long clinical experience in lymphedema treatment; the questionnaire was developed in a well thought out manner using an established epidemiological approach [19,122-124], which makes this questionnaire another strength of the study.

This intervention study was controlled, but not randomized, and three different cities were chosen for practical reasons, which may have introduced a risk of confounding. Comparability in demographics in the groups and our seeing to it that the groups were studied during comparable time periods strengthens the study's internal validity. Our sample size calculation from the beginning was based on a larger group than we succeeded in including in the final study. Intervention studies are complex and the number of participants who agreed to participate was reduced because of practical and medical issues. Practical issues were that the colder pool and gymnastic hall were too far away from the participants' homes and that the time in the evening did not suit them. The survivors were asked by the physiotherapeutic clinics if they wanted to take part in the study. We may have chosen the most well motivated women, which may have had an effect on internal validity; so called self-selection bias. The drop-out rate from baseline was 19%, so we think there is only a small risk that the number of participants in the study has influenced the validity of our results. Six women in the land exercise group dropped out because the training was too strenuous. These women were the somewhat elderly women (over 80). Perhaps elderly women could preferably be recommended for water exercise instead of land exercise if aerobic training is to be chosen. Four women in the land exercise group were excluded from the final analysis because they did not reach our pre-study criteria for the compliance rate (participating seven times). Compared with the higher compliance in the water exercise group, this may be a confounder, influencing the validity of the results, but may also be an indication that water exercise is better tolerated by individuals with physical impairments.

Self-reported BMI was reduced in the water exercise group. One risk factor for developing or worsening lymphedema is a BMI over 30 [120,146] and finding exercise forms that can affect the women's weight can be particularly important. The reduction of BMI in our study is not in line with one other study comparing the two training forms, where reduction of BMI was instead reported for those engaging in land exercise[120]. Perhaps the colder water (<29° C) made it possible to use more intensive training, which could be the explanation for the reduced BMI in our study. There could also be a hidden self-reported bias in the reduced BMI.

The land exercise group improved their daily physical shoulder function and joint mobility. This contrasts with results from another study[120] where the improvement was rather a result of water exercise. The DASH questionnaire includes questions that mostly are about daily movements above 90° in the shoulder joint. One can speculate if land exercise is more effective in influencing certain movements compared to the water exercise where the arms are held in line with the water surface. Elevation in the shoulder decreased after land exercise, and we can perhaps explain that as resulting from a measurement error of 4-5° with regard to clinical relevance[133,134].

Well-being did not differ in or between the groups in this study. The term "well-being" used in our study may be compared to use of the term in studies that use inventories or questionnaires measuring "quality-of-life" (QOL). Well-being is perhaps a more direct and intuitive concept than QOL that individuals can respond to directly, different from summary scores of QOL answers constructed by the health care system. In our study, well-being was scored high from the start in all groups, and therefore it is not reasonable to expect any improvements in any of the groups or in-between. Significant improvements of QOL after interventions have been shown in other studies on secondary lymphedema[109,121].

Body-image did not show any significant differences in or between the groups. We know from earlier studies [82] that lymphedema often has a negative influence on body-image and that a long period of physical activity intervention can improve body-image [113]. In this context, the intervention in this study might have been too short to really influence the body-image outcome.

In order to reduce objective and self-reported swelling, female cancer survivors with lymphedema may be offered water exercise training. To improve daily shoulder function one may speculate if movements above the water surface may affect specific functions. In the future, exercise programs with additional shoulder elements could be included.

Our study showed that physical exercise did not worsen lymphedema, a result in line with other studies[108,109,111,144,145]. Individuals with lymphedema should no longer be afraid to perform physical exercise, but it is to be remembered that we do not know if there may be certain at-risk patients. It has been reported that weight lifting exercises can be a trigger for erysipelas in lower leg lymphedema[114]. More and more detailed research has to be carried out on the risks and predictors for developing lymphedema with regards to physical exercise. On the other hand,

cancer survivors also very often suffer from fatigue, and physical exercise in water is one way to reduce this[155].

It can be an advantage that the participants performed exercises in colder water (<29° C) because participants find exercising in warmer water to be tiring and this might have made the participants slow down not reaching the desired intense training level, which was the goal of using water intervention in this study. Warmer water of 33-34° C is the most common water temperature for individuals with lymphedema treated in physiotherapy. Such programs have been used for many years, but to our knowledge no one has studied if water training can reduce lymphedema limb volume. The purpose of exercising in warmer water is often to increase mobility and give the patient with functional disability the possibility of training. Tidhar used warmer water (33° C) in her study about Aqua Lymphatic Therapy[121]. The intervention in that study was slow motion of the limbs and massage under water, methods not used in our study. We know from other studies that aerobic exercise, as this kind of exercise is often called, has to be done at least twice a week to obtain any influence on physical changes and that the changes can persist after three months[120]. In our study did we not have the practical opportunities to perform the intervention twice a week, however the results even showed significance for some of the predicted outcomes.

7 CONCLUSIONS

Our research will hopefully lead to better understanding and highlight the importance of the female survivor's active part in lymphedema treatment. Fully developed self-care as part of the survivors' daily life provides good well-being, and improved reception from health-care providers at an early stage including early detection and information especially for the lower leg lymphedema survivors can improve their situation. Development of evidence based knowledge about self-care is essential if self-care is to become more comprehensive and effective.

Our studies indicate that self-care involves physical, psychological and social aspects, which means that attention should be given to all these aspects to help patients adhere to their self-care programs. We also need to understand that acceptance of having lymphedema can empower the patients to actually deal with self-care. Over half of the women with secondary lymphedema performed self-care every day at home even though half of all women reported that self-care did not help. We have to be aware that the female cancer survivors with low well-being, women who report difficulties with accepting their body, and women with ethnicities other than Swedish may need special attention because they are at higher risk of not following a self-care program.

Possible improvements from physical exercise can be one part of self-care for the women. We found that a greater proportion of women displayed a decrease in secondary lymphedema volume after water exercise than after land exercise. The water exercise group also displayed a reduction in BMI and in self-reported frequency of swelling after the intervention. However, the

size of the limb volume reduction did not differ between the types of exercise. In the land group improvements were shown in daily shoulder function, measured with DASH and in outer rotation of the shoulder after intervention.

8 IMPLICATIONS AND FUTURE RESEARCH

We need to highlight the significance of lower limb lymphedema and the impact it has on daily living and quality-of-life. It is important to take more effective action and to begin to actively ask our pelvic cancer patients about signs and symptoms of pain, swelling and heaviness in the pelvic region after treatment in order to help or refer these patients to experts in this field.

We could ask ourselves:

Do we have early detection of lower limb lymphedema?

Are the early signs and symptoms known by physicians outside the oncological health care area?

How do we interpret the question about well-being and daily function when we meet these women in the clinic?

We need to help the patients to talk about the obstacles they face in following a self-care routine. We could motivate them to see the good things about themselves when self-care gives result and talk openly with them about their frustration and guilt about not doing enough. A dialogue with others in the same situation, support from family and friends, and good advice from health care providers can empower the women, increase their self-esteem and make them feel good, and thus actually improve their ability to do self-care.

All patients need appropriate information and instructions in self-care. Special attention needs to be directed to cancer survivors at risk for not performing self-care such as women with other ethnicity, low well-being and low acceptance of their body. It is important to take action and capture the above described subgroups of women with lymphedema and implement self-care with better perception of their daily life situation.

We could ask ourselves:

Do we pay enough attention to all dimensions in self-care, the physical, social and physiological parts?

Can we talk with our patients about obstacles, guilt and the fear that the women experience in performing self-care?

Do we have a perspective of each individual as someone who has abilities and their own resources rather than seeing them simply as victims of sickness and suffering?

Can we develop follow-up questions for the women about their well-being, body-image and maybe also the consequences of their difficulties in understanding the spoken or written language?

Exercise in different forms could be developed for the women with secondary lymphedema. Not worsening the lymphedema and the other general benefits of being active are all in some way good, but they are not enough. We might also start to look more carefully at physical exercise as a means of reducing the negative impacts of secondary lymphedema. Water exercise can be a suitable treatment in secondary lymphedema reducing limb volume and BMI. Land exercise on the other hand can be an exercise form for the women who need improvements in their daily life functioning and in joint mobility.

To guide future female cancer survivors with lymphedema to follow effective exercise programs that can result in reduced limb volume and improved function, we need to develop adequate evidenced-based programs, e.g. observed and examined in the clinic when we meet these women.

We could ask ourselves:

How do we use physical exercise today in the clinic when meeting women with secondary lymphedema?

Do we use the water exercise as a probable method for reducing the effects of secondary lymphedema?

Do we evaluate every exercise intervention that we start to determine if it can be improved and developed to better meet the women's needs?

Do we understand the effects of land gymnastic on secondary lymphedema?

The future is here already and we could start by looking at patients with lymphedema as if they have their own resources rather than simply seeing them as individuals who want to be totally dependent on the health care provider? We can help them to push their motivation and support them when self-care fails or the disease is in a relapse. The best help is to empower them to believe in themselves.

For all research in the area of lymphedema treatment, there are certain topics which could be described, examined, explored and declared. First we have to know more about the different parts of physical self-care and their individual effects. We also need consensus documents and reviews of self-care research. Holistic dimensions outside the simple explanation of self-care as something the patients do manually and physically are needed. We could also investigate the possibility of developing new physiological or behavioral methods to help our patients in performing self-care. One step could be to use as an evidence base the motivational interviews which have been used in health care in recent years. I also think that some kind of follow up

questionnaire including areas such as well-being, body-image and maybe ethnical issues could be developed and interpreted in the clinic. Our resources should be first focused on the patients who are more vulnerable for not performing self-care; the patients who lack the motivation are the ones we should focus on. The ones who can and will are not the women we should invest our resources on at first.

Physical exercise is an interesting and up-and-coming area of evidence-based approaches for eventually resulting in improvements in treatment of lymphedema. At first water exercise in larger, randomized studies where it is also required to compare different water temperatures except for the depth in water and the hydrostatical pressure could be researched. Land exercise is well known from strength training; what we do not know so much about is whether general gymnastic or aerobic exercises are best for improving lymphedema, so here is another current method to examine and develop.

8.1 SYNTHESIS

This thesis indicates that we could be aware of predicting factors for self-care that can influence female cancer survivors with secondary lymphedema. Factors such as anxiety, low well-being, quality of sleep and negative body image are just some of the factors that could be given more attention in the clinicians' medical records and give us a hint of greater need for rehabilitation for more exposed female survivors. Early signs and symptoms especially for lower limb lymphedema have to be recognized and reported more carefully in medical records as well. Quality of sleep may be a factor both influencing the gynecological female survivor's quality of life and also predicting factor for self-care for female survivors over all. Self-care is something more comprehensive than manual physical treatment performed by the female survivors; it includes analysis even of the psychosocial aspects that must be taken into consideration to really support the women. Physical activity or exercise can be one part of self-care. Physical activity/exercise has earlier been highlighted as a positive way to influence the women's quality of life as survivors, and maybe it is time now to implement physical exercise that can improve even the secondary lymphedema status. Let us hope that this thesis can be an innovation leading to more and larger studies on water and land exercise interventions. We know that exercise can be a benefit and directly influence strength and mobility, but also increase well-being and on that basis also give direct improvements on daily life function. It can also be a turn-around – causality here where better daily function gives the female survivors better scores in quality of life (figure 17).

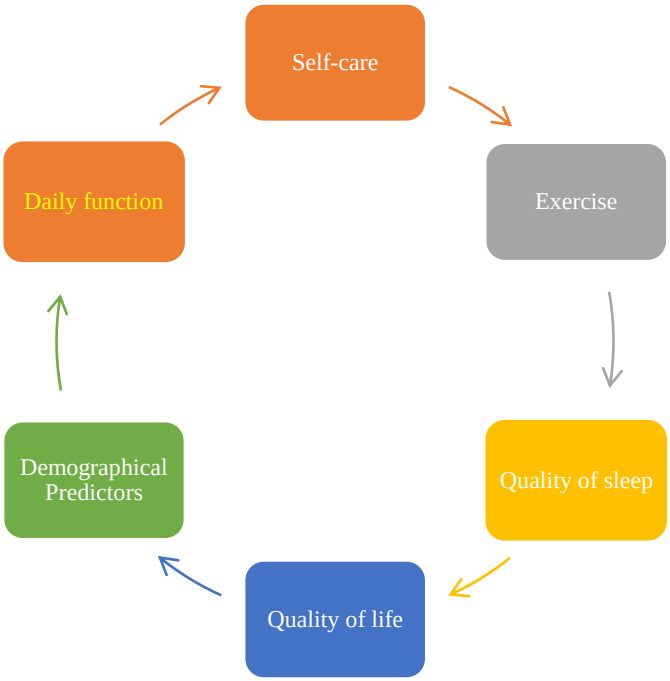


Figure 17. Synthesis

9 SAMMANFATTNING PÅ SVENSKA

Stor del av forskning kring behandling av kvinnor som behandlats för t cancer och lider av sekundärt lymfödem fokuseras på åtgärder givna av sjukvården. Denna avhandling har istället fokus på kvinnornas egen aktivitet i det dagliga livet, egenvård och fysisk träning för att förhindra progress av svullnaden och ge ökad självkontroll. Människor som drabbas av kronisk sjukdom kan följa tre steg för att nå optimal hälsa. Första steget vid lymfödem är att få kontroll över sjukdomen och se till att den inte fortskrider med kombinerad ödemterapi eller ibland endast instruktion i egenvård given av oss i sjukvården. I det andra steget beror det bibehållna resultat av steg ett på kvinnornas egen förmåga att ta hand om sig med egenvård mellan besöken i sjukvården. Så slutligen krävs eventuellt förändrad livsstil, såsom viktnedgång, fysisk aktivitet, balans mellan aktivitet och vila för att inte förvärra situationen. Dessa teser har sin ansats i de två sista stegen i denna teori. Kvinnornas egen aktivitet för att behålla hälsa och välmående, är en viktig del för att nå integritet, fungerande funktion och mänsklig utveckling i en ofta omtumlande livssituation. Studierna i denna avhandling hade som mål att undersöka, beskriva, utvärdera och förklara den egen aktiva delen av kvinnornas behandling i det dagliga livet utifrån både fysiska och psykiska och sociala faktorer. Vi genomförde fyra studier för att kartlägga daglig funktion och välbefinnande, egenvård och effekter av fysisk träning.

I delarbete ett genomfördes en studie av 786 kvinnor med gynekologisk cancer, som genomgått strålbehandling, samt kvinnor i en kontrollgrupp som inte fått strålbehandling. Kvinnorna besvarade ett studiespecifikt formulär med 351 frågor om symtom efter cancerbehandlingen från mag-tarm-kanalen, urinvägar, genitalier, lymfsystemet, bäckenet och benen. Den studiespecifika enkäten var validerad utifrån en epidemiologisk metod. Frågorna fokuserade

även på demografi, sexuell funktion, mental hälsa, livskvalitet och social funktion. Delarbete ett handlar om den del av formuläret (19 frågor) som behandlar kvinnornas besvär från lymfsystemet. Vi fann att lymfödem i nedre extremiteten försämrade kvinnornas sömn, dagliga funktion och livskvalitet. I delarbete två beskriver vi kvinnornas uppfattning om egenvård vid sekundärt lymfödem. En intervjustudie med fenomenografisk ansats genomförs på 21 tillfrågade och 8 slutligen deltagande kvinnor. Studien pekar på att egenvård inbegriper fysiska, psykiska och sociala aspekter, vilket indikerar att alla delar kan inkluderas för att stödja kvinnorna att utföra egenvård. Acceptans av sjukdomen kan också stärka kvinnornas förmåga att anpassa sig till egenvården i det dagliga livet. Som sjukvårdspersonal behöver vi vara öppna för att tala med kvinnorna om de hinder som uppstår när de ska anpassa sitt liv till egenvård. I delarbete tre undersökte vi bakomliggande faktorer som kan påverka frekvens och utförande av egenvård hos kvinnor med sekundärt lymfödem i en kohort av 83 deltagare. Vi fann att 58 % utförde egenvård någon gång varje dag men halva studiegruppen ansåg inte att egenvård hjälpte. Faktorer som påverkade utfallet egenvård var, lågt välbefinnande och kvinnor som rapporterade svårigheter att acceptera sin kropp samt att ha annan etnicitet än svensk.

Slutligen genomförde vi en klinisk kontrollerad intervention med 88 deltagande kvinnor med sekundärt lymfödem. Syftet i delarbete fyra var att jämföra vattenträning med landträning och standardbehandling vid sekundärt lymfödem. Vi fann att ett högre antal av de kvinnor som deltog i vattenträningen minskade i armvolym, BMI och självupplevd svullnad efter jämfört med före interventionen. Kvinnorna i landträningen fick förbättrad funktion samt skulder rörlighet (utåtrotation). Det centrala budskapet i denna avhandling är att vi fokuserat på canceröverlevares egen resurs och aktivitet i behandlingen av lymfödem.

Kunskapen som utfaller ur denna avhandling kan användas för att än mer aktivt än idag, fråga kvinnliga canceröverlevare med gynekologisk eller bröstrelaterad cancersjukdom om komplikationer och symtom från lymfsystemet för att fånga svullnadsbesvär i tidigt skede och förhindra progress av lymfödem och den negativa inverkan det har på kvinnornas livskvalitet och dagliga funktion. I vårt bemötande kring egenvård av kvinnor med sekundärt lymfödem kan vi föra en aktiv och tydlig dialog där kvinnorna får uttrycka frustration och hinder i egenvården och få vägledning i detta både fysiskt, psykiskt och socialt. Vi kan också motivera kvinnorna till att nå acceptans av sjukdomen för att underlätta för dem att utföra och anpassa sig till egenvård vid sekundärt lymfödem. I mötet och i uppföljning av kvinnor med sekundärt lymfödem kan vi se bakomliggande försvagande faktorer för att inte utföra egenvård såsom lågt välbefinnande och negativ kroppsuppfattning och annan etnicitet än svensk. Mer resurser kan ägnas åt sårbara grupper för att förhindra att en låg grad av egenvård förvärrar situationen ytterligare vid sekundärt lymfödem. Vi vet idag att fysisk träning inte förvärrar lymfödem, och vår studie indikerar att det även skulle kunna förbättra lymfödemet vad gäller utfallet volym, självskattad svullnad och BMI. Fysisk träning kan om den ytterligare evidensbaseras i framtida studier bli en del av kvinnornas egen aktiva behandling av sekundärt lymfödem.

10 ACKNOWLEDGEMENTS

My deepest gratitude to the ***Female Cancer Survivors***

Karin Bergmark for inviting me in to the research group on Clinical Cancer Epidemiology, for your *very precise* review of my manuscript drafts, sharing your deep knowledge and developing conversations about clinical cases.

Anna Enblom for reviewing my manuscript drafts, and always challenging me to examine new scientific perspectives.

Gail Dunberger for offering advice on manuscript drafts and for your knowledge and down to earth perspective on practical matters.

Tommy Nyberg for always having been there for me with your terrific statistical knowledge and patience with doctoral students.

Kamila Czene came into my thesis at half-time and you have given me the best a mentor can give. You became irreplaceable in my eyes.

Gunnar Steineck for the developing research environment and the best of the clinical research school at Sahlgrenska Academy.

Our late Professor ***Olle Söderhamn.*** Who gave me the best of starts into the self-care field, supervised me in my first scientific study "Knowledge and self-care in relation to Lymphedema School". I feel deep sorrow to not be able to share this moment with Olle.

Colleauges on KCE for all chats with you and deeper research discussions. Proud of you all!

Tove Bylund Grenklo for your deep knowledge and for giving me direction when needed, Pernilla Omerov for inspiration, especially about my questionnaire, Rosanna Peterssén for your calm and friendly appearance and for sharing your knowledge with me, Malin Lövgren for deep and interesting chats, Maria Bom for sharing a deep and spiritual level of life, Camilla Byström for your kindness, Cornelia Byström for your patience with all the data punching, Victor Skocic for being just the one you are, Else Lundin for help with sending out the questionnaires, Ulrika Kreichbergs for being there at the beginning of my thesis research, Hanan El Malla for your friendship, Anna Christensen supported me a lot in the beginning when I felt new and unsure, Alexandra Eilegård Wallin for your kindness and smile, Mohammad Hossein Hajiebrahimi for always having a glint in your eye, Alexandra Hofsjö for our supportive chats about being a PhD student, Margareta Wärja for your special attention to my psychological thoughts (you are the next ONE) and to Sara Burkhill for reading my framework and English writing and to Larry Lundgren who did the final ambitious editing.

Ylva Widgren, Eva Ahlner, Veronika Shitaz and Pia Klernäs, my physiotherapist colleagues did all measurements in the clinical intervention study. Thank You for your patience and accuracy!

Yvonne Björk, Annika Aldenbratt and Karin Stinesen Kollberg my dearest clinical research educational colleagues at Sahlgrenska Academy, always meeting me with a smile and good friendship.

Fritjof and Lovisa Reuterborg for the good time and lively conversations I had staying at your bed and breakfast, Ängården during the years of research education in Gothenburg.

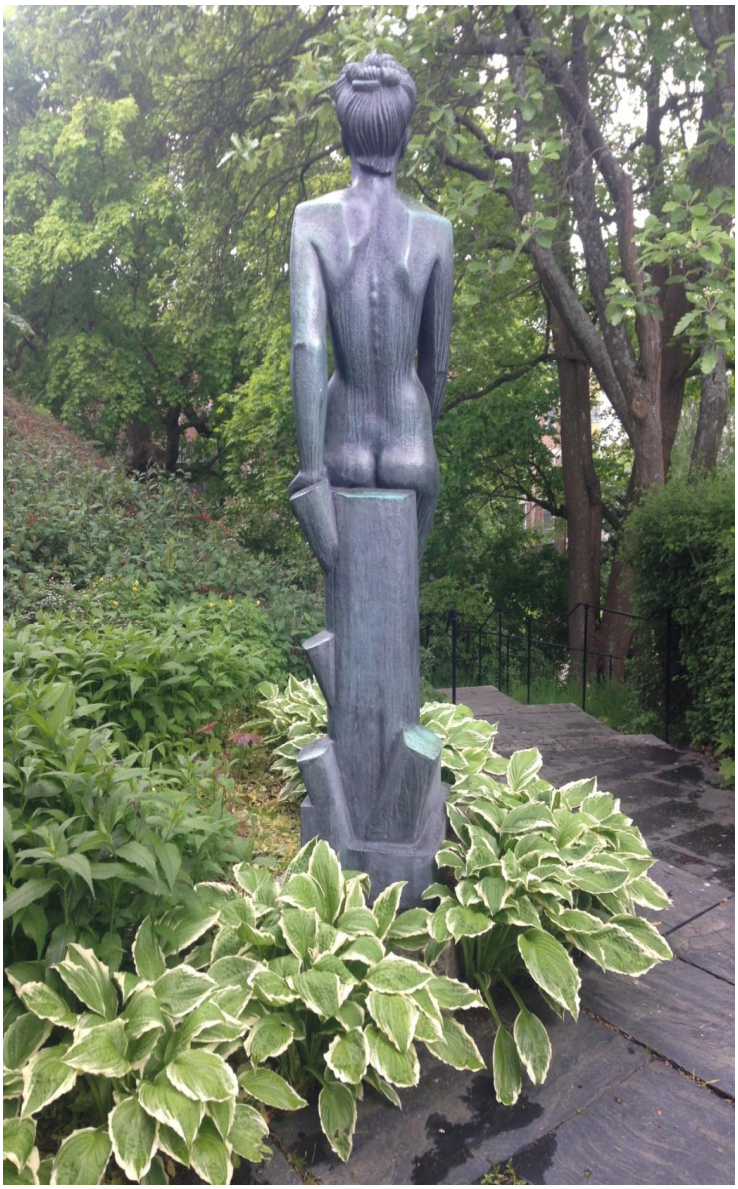
To my beloved Urban Warberg who always is there as a rock whatever happens. You have an angel's patience Urban and have my deepest love.

I also express my gratitude to my parents. My father, the late ***Helge Lindquist*** who gave me my curiosity, life fullness, creativity and even the obstinate part of me. My mother ***Estrid Lindquist***, for giving me wisdom, patience and a down-to earth perspective.

My older sisters ***Maud***, ***Åsa*** and ***Anne*** for being who you are!

To all my sisters and brothers met in life, my dear friends. My deepest thanks for letting me be your friend, you are all very special to me.

To the Lord and Jesus Christ, my deepest love and comfort in life.



To the female cancer survivors!

11 REFERENCES

1. Antonovsky A. *Health, stress, and coping.* 1st ed. San Francisco: Jossey-Bass Publishers; 1980.

2. Lindstrom B, Eriksson M. Salutogenesis. *Journal of epidemiology and community health.* Jun 2005;59(6):440-442.

3. Lindstrom B, Eriksson M. Contextualizing salutogenesis and Antonovsky in public health development. *Health promotion international.* Sep 2006;21(3):238-244.

4. Heim E. [Salutogenesis versus pathogenesis--a new approach to an old wisdom]. *Schweizerische medizinische Wochenschrift.* Jul 23 1994;124(29):1267-1275.

5. Foldi E. The treatment of lymphedema. *Cancer.* Dec 15 1998;83(12 Suppl American):2833-2834.

6. Foldi E, Sauerwald A, Hennig B. Effect of complex decongestive physiotherapy on gene expression for the inflammatory response in peripheral lymphedema. *Lymphology.* Mar 2000;33(1):19-23.

7. Honnor A. The management of chronic oedema in palliative care. *British journal of community nursing.* Oct 2008;13(10):S4-9.

8. Orem DE. A concept of self-care for the rehabilitation client. *Rehabilitation nursing : the official journal of the Association of Rehabilitation Nurses.* May-Jun 1985;10(3):33-36.

9. Cooper K, Smith BH, Hancock E. Patients' perceptions of self-management of chronic low back pain: evidence for enhancing patient education and support. *Physiotherapy.* Mar 2009;95(1):43-50.

10. Audulv A, Asplund K, Norbergh KG. The integration of chronic illness self-management. *Qualitative health research.* Mar 2012;22(3):332-345.

11. al MSe. Consensus recommendations for cancer rehabilitation: research and education priorities. *Current oncology.* 2013;20(1):64-69.

12. Morone G, Iosa M, Fusco A, et al. Effects of a multidisciplinary educational rehabilitative intervention in breast cancer survivors: the role of body image on quality of life outcomes. *TheScientificWorldJournal.* 2014;2014:451935.

13. Jansen F, van Uden-Kraan CF, van Zwieten V, Witte BI, Verdonck-de Leeuw IM. Cancer survivors' perceived need for supportive care and their attitude towards self-management and eHealth. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Jun 2015;23(6):1679-1688.

14. Radina ME, Armer JM, Stewart BR. Making self-care a priority for women at risk of breast cancer-related lymphedema. *Journal of family nursing.* May 2014;20(2):226-249.

15. Forouzanfar MH, Foreman KJ, Delossantos AM, et al. Breast and cervical cancer in 187 countries between 1980 and 2010: a systematic analysis. *Lancet.* Oct 22 2011;378(9801):1461-1484.

16. Bosetti C, Bertuccio P, Malvezzi M, et al. Cancer mortality in Europe, 2005-2009, and an overview of trends since 1980. *Annals of oncology : official journal of the European Society for Medical Oncology / ESMO.* Oct 2013;24(10):2657-2671.

17. Wade TD, Lee C. The impact of breast cancer on the lives of middle-aged women: results from the Australian longitudinal study of women's health. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* May 2005;24(3):246-251.

18. Salonen P, Rantanen A, Kellokumpu-Lehtinen PL, Huhtala H, Kaunonen M. The quality of life and social support in significant others of patients with breast cancer--a longitudinal study. *European journal of cancer care.* Mar 2014;23(2):274-283.

19. Johansson E, Steineck G, Holmberg L, et al. Long-term quality-of-life outcomes after radical prostatectomy or watchful waiting: the Scandinavian Prostate Cancer Group-4 randomised trial. *The Lancet. Oncology.* Sep 2011;12(9):891-899.

20. Ridner SH. Quality of life and a symptom cluster associated with breast cancer treatment-related lymphedema. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Nov 2005;13(11):904-911.

21. Sakorafas GH, Peros G, Cataliotti L, Vlastos G. Lymphedema following axillary lymph node dissection for breast cancer. *Surgical oncology.* Nov 2006;15(3):153-165.

22. Johansson K, Branje E. Arm lymphoedema in a cohort of breast cancer survivors 10 years after diagnosis. *Acta Oncol.* 2010;49(2):166-173.

23. Ahmed RL, Schmitz KH, Prizment AE, Folsom AR. Risk factors for lymphedema in breast cancer survivors, the Iowa Women's Health Study. *Breast cancer research and treatment.* Dec 2011;130(3):981-991.

24. Park JH, Lee WH, Chung HS. Incidence and risk factors of breast cancer lymphoedema. *Journal of clinical nursing.* Jun 2008;17(11):1450-1459.

25. Gartner R, Mejdahl MK, Andersen KG, Ewertz M, Kroman N. Development in self-reported arm-lymphedema in Danish women treated for early-stage breast cancer in 2005 and 2006--a nationwide follow-up study. *Breast.* Aug 2014;23(4):445-452.

26. Gartner R, Jensen MB, Kronborg L, Ewertz M, Kehlet H, Kroman N. Self-reported arm-lymphedema and functional impairment after breast cancer treatment--a nationwide study of prevalence and associated factors. *Breast.* Dec 2010;19(6):506-515.

27. Dominick SA, Madlensky L, Natarajan L, Pierce JP. Risk factors associated with breast cancer-related lymphedema in the WHEL Study. *Journal of cancer survivorship : research and practice.* Mar 2013;7(1):115-123.

28. Beesley V, Janda M, Eakin E, Obermair A, Battistutta D. Lymphedema after gynecological cancer treatment : prevalence, correlates, and supportive care needs. *Cancer.* Jun 15 2007;109(12):2607-2614.

29. Ibrahim AO, Alawad AA. Risk factors and Management of Breast Cancer-Related Lymphedema. *International journal of medicine.* 2015;3(1):38-40.

30. Das N, Baumgartner RN, Riley EC, Pinkston CM, Yang D, Baumgartner KB. Treatment-related risk factors for arm lymphedema among long-term breast cancer survivors. *Journal of cancer survivorship : research and practice.* Apr 26 2015.

31. Ostby PL, Armer JM, Dale PS, Van Loo MJ, Wilbanks CL, Stewart BR. Surveillance recommendations in reducing risk of and optimally managing breast cancer-related lymphedema. *Journal of personalized medicine.* 2014;4(3):424-447.

32. Hidding JT, Beurskens CH, van der Wees PJ, van Laarhoven HW, Nijhuis-van der Sanden MW. Treatment related impairments in arm and shoulder in patients with breast cancer: a systematic review. *PloS one.* 2014;9(5):e96748.

33. Lee D, Hwang JH, Chu I, Chang HJ, Shim YH, Kim JH. Analysis of factors related to arm weakness in patients with breast cancer-related lymphedema. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Jan 10 2015.

34. O'Toole JA, Ferguson CM, Swaroop MN, et al. The impact of breast cancer-related lymphedema on the ability to perform upper extremity activities of daily living. *Breast cancer research and treatment.* Apr 2015;150(2):381-388.

35. Liu FX, Flatt SW, Pakiz B, et al. Physical activity levels of overweight or obese breast cancer survivors: correlates at entry into a weight loss intervention study. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* May 15 2015.

36. Pakiz B, Ganz PA, Sedjo RL, et al. Correlates of quality of life in overweight or obese breast cancer survivors at enrollment into a weight loss trial. *Psycho-oncology.* Apr 29 2015.

37. Hopwood P, Fletcher I, Lee A, Al Ghazal S. A body image scale for use with cancer patients. *European journal of cancer.* Jan 2001;37(2):189-197.

38. Begovic-Juhant A, Chmielewski A, Iwuagwu S, Chapman LA. Impact of body image on depression and quality of life among women with breast cancer. *Journal of psychosocial oncology.* 2012;30(4):446-460.

39. Taghian NR, Miller CL, Jammallo LS, O'Toole J, Skolny MN. Lymphedema following breast cancer treatment and impact on quality of life: a review. *Critical reviews in oncology/hematology.* Dec 2014;92(3):227-234.

40. Li L, Zhu X, Yang Y, et al. Cognitive emotion regulation: characteristics and effect on quality of life in women with breast cancer. *Health and quality of life outcomes.* 2015;13(1):51.

41. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *International journal of cancer. Journal international du cancer.* Dec 15 2010;127(12):2893-2917.

42. Bergmark K, Avall-Lundqvist E, Dickman PW, Henningsohn L, Steineck G. Lymphedema and bladder-emptying difficulties after radical hysterectomy for early cervical cancer and among population controls. *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* May-Jun 2006;16(3):1130-1139.

43. Finnane A, Hayes SC, Obermair A, Janda M. Quality of life of women with lower-limb lymphedema following gynecological cancer. *Expert review of pharmacoeconomics & outcomes research.* Jun 2011;11(3):287-297.

44. Ryan M, Stainton MC, Jaconelli C, Watts S, MacKenzie P, Mansberg T. The experience of lower limb lymphedema for women after treatment for gynecologic cancer. *Oncology nursing forum.* May-Jun 2003;30(3):417-423.

45. Kim JH, Choi JH, Ki EY, et al. Incidence and risk factors of lower-extremity lymphedema after radical surgery with or without adjuvant radiotherapy in patients with FIGO stage I to stage IIA cervical cancer. *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* May 2012;22(4):686-691.

46. Dunberger G, Lindquist H, Waldenstrom AC, Nyberg T, Steineck G, Avall-Lundqvist E. Lower limb lymphedema in gynecological cancer survivors--effect on daily life functioning. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Nov 2013;21(11):3063-3070.

47. Bergmark K, Avall-Lundqvist E, Dickman PW, Henningsohn L, Steineck G. Patient-rating of distressful symptoms after treatment for early cervical cancer. *Acta obstetricia et gynecologica Scandinavica.* May 2002;81(5):443-450.

48. Werngren-Elgstrom M, Lidman D. Lymphoedema of the lower extremities after surgery and radiotherapy for cancer of the cervix. *Scandinavian journal of plastic and reconstructive surgery and hand surgery / Nordisk plastikkirurgisk forening [and] Nordisk klubb for handkirurgi.* Dec 1994;28(4):289-293.

49. Badger C, Preston N, Seers K, Mortimer P. Physical therapies for reducing and controlling lymphoedema of the limbs. *The Cochrane database of systematic reviews.* 2004(4):CD003141.

50. Beesley VL, Rowlands IJ, Hayes SC, et al. Incidence, risk factors and estimates of a woman's risk of developing secondary lower limb lymphedema and lymphedema-specific supportive care needs in women treated for endometrial cancer. *Gynecologic oncology.* Jan 2015;136(1):87-93.

51. Kusters I, Williams M, Obermair A, Janda M. Women with self-reported lower-limb lymphedema after treatment for gynecological cancers: are they more likely to self-report psychosocial symptoms and less likely to use services? *The Journal of community and supportive oncology.* Feb 2015;13(2):55-61.

52. Bergmark K, Lundqvist EA, Steineck G. [A Swedish study of women treated for cervix cancer. Gynecologic cancer often affects sexuality]. *Lakartidningen.* Nov 15 2000;97(46):5347-5355.

53. Hoogendam JP, Verheijen RH, Wegner I, Zweemer RP. Oncological outcome and long-term complications in robot-assisted radical surgery for early stage cervical cancer: an observational cohort study. *BJOG : an international journal of obstetrics and gynaecology.* Nov 2014;121(12):1538-1545.

54. Akhtar-Danesh N, Elit L, Lytwyn A. Trends in incidence and survival of women with invasive vulvar cancer in the United States and Canada: a population-based study. *Gynecologic oncology.* Aug 2014;134(2):314-318.

55. Farrell R, Gebski V, Hacker NF. Quality of life after complete lymphadenectomy for vulvar cancer: do women prefer sentinel lymph node biopsy? *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* May 2014;24(4):813-819.

56. Hinten F, van den Einden LC, Hendriks JC, et al. Risk factors for short- and long-term complications after groin surgery in vulvar cancer. *British journal of cancer.* Oct 25 2011;105(9):1279-1287.

57. Gaarenstroom KN, Kenter GG, Trimbos JB, et al. Postoperative complications after vulvectomy and inguinofemoral lymphadenectomy using separate groin incisions. *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* Jul-Aug 2003;13(4):522-527.

58. Dunberger G, Lind H, Steineck G, et al. Fecal incontinence affecting quality of life and social functioning among long-term gynecological cancer survivors. *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* Apr 2010;20(3):449-460.

59. Bergmark K, Avall-Lundqvist E, Dickman PW, Henningsohn L, Steineck G. Vaginal changes and sexuality in women with a history of cervical cancer. *The New England journal of medicine.* May 6 1999;340(18):1383-1389.

60. Dunberger G, Lind H, Steineck G, Waldenstrom AC, Onelov E, Avall-Lundqvist E. Loose stools lead to fecal incontinence among gynecological cancer survivors. *Acta Oncol.* Feb 2011;50(2):233-242.

61. Nout RA, van de Poll-Franse LV, Lybeert ML, et al. Long-term outcome and quality of life of patients with endometrial carcinoma treated with or without pelvic radiotherapy in the post operative radiation therapy in endometrial carcinoma 1 (PORTEC-1) trial. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology.* May 1 2011;29(13):1692-1700.

62. Dunberger G, Lind H, Steineck G, et al. Self-reported symptoms of faecal incontinence among long-term gynaecological cancer survivors and population-based controls. *European journal of cancer.* Feb 2010;46(3):606-615.

63. Pfaendler KS, Wenzel L, Mechanic MB, Penner KR. Cervical cancer survivorship: long-term quality of life and social support. *Clinical therapeutics.* Jan 1 2015;37(1):39-48.

64. Joly F, McAlpine J, Nout R, et al. Quality of life and patient-reported outcomes in endometrial cancer clinical trials: a call for action! *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* Nov 2014;24(9):1693-1699.

65. Biglia N, Librino A, Ottino MC, Panuccio E, Daniele A, Chahin A. Lower limb lymphedema and neurological complications after lymphadenectomy for gynecological cancer. *International journal of gynecological cancer : official journal of the International Gynecological Cancer Society.* Mar 2015;25(3):521-525.

66. Fang P, Tan KS, Grover S, McFadien MK, Troxel AB, Lin L. Psychosocial encounters correlates with higher patient-reported functional quality of life in gynecological cancer patients receiving radiotherapy. *Radiation oncology.* 2015;10(1):34.

67. Rowlands IJ, Beesley VL, Janda M, et al. Quality of life of women with lower limb swelling or lymphedema 3-5 years following endometrial cancer. *Gynecologic oncology.* May 2014;133(2):314-318.

68. Lockwood-Rayermann S. Lymphedema in gynecologic cancer survivors: an area for exploration? *Cancer nursing.* Jul-Aug 2007;30(4):E11-18.

69. Collin AC, Girod A, Pinet-Isaac S, et al. [Detection of the sentinal node by lymphoscintigraphy in squamous-cell carcinoma of the oral cavity: a prospective study

of 31 patients]. *Revue de stomatologie et de chirurgie maxillo-faciale.* Apr 2005;106(2):69-74.

70. Foldi E, Foldi M. [Anatomic basis for the treatment of lymphedema]. *Schweizerische Rundschau fur Medizin Praxis = Revue suisse de medecine Praxis.* Nov 15 1983;72(46):1459-1464.

71. Warren AG, Brorson H, Borud LJ, Slavin SA. Lymphedema: a comprehensive review. *Annals of plastic surgery.* Oct 2007;59(4):464-472.

72. Szuba A, Rockson SG. Lymphedema: classification, diagnosis and therapy. *Vascular medicine.* 1998;3(2):145-156.

73. Finnane A, Liu Y, Battistutta D, Janda M, Hayes SC. Lymphedema after breast or gynecological cancer: use and effectiveness of mainstream and complementary therapies. *Journal of alternative and complementary medicine.* Sep 2011;17(9):867-869.

74. Cheville AL, McGarvey CL, Petrek JA, Russo SA, Thiadens SR, Taylor ME. The grading of lymphedema in oncology clinical trials. *Seminars in radiation oncology.* Jul 2003;13(3):214-225.

75. Ohba Y, Todo Y, Kobayashi N, et al. Risk factors for lower-limb lymphedema after surgery for cervical cancer. *International journal of clinical oncology.* Jun 2011;16(3):238-243.

76. Tsai RJ, Dennis LK, Lynch CF, Snetselaar LG, Zamba GK, Scott-Conner C. The risk of developing arm lymphedema among breast cancer survivors: a meta-analysis of treatment factors. *Annals of surgical oncology.* Jul 2009;16(7):1959-1972.

77. Lawenda BD, Mondry TE, Johnstone PA. Lymphedema: a primer on the identification and management of a chronic condition in oncologic treatment. *CA: a cancer journal for clinicians.* Jan-Feb 2009;59(1):8-24.

78. Szuba A, Achalu R, Rockson SG. Decongestive lymphatic therapy for patients with breast carcinoma-associated lymphedema. A randomized, prospective study of a role for adjunctive intermittent pneumatic compression. *Cancer.* Dec 1 2002;95(11):2260-2267.

79. Szuba A, Cooke JP, Yousuf S, Rockson SG. Decongestive lymphatic therapy for patients with cancer-related or primary lymphedema. *The American journal of medicine.* Sep 2000;109(4):296-300.

80. Sackey H, Johansson H, Sandelin K, et al. Self-perceived, but not objective lymphoedema is associated with decreased long-term health-related quality of life after breast cancer surgery. *European journal of surgical oncology : the journal of the European Society of Surgical Oncology and the British Association of Surgical Oncology.* Apr 2015;41(4):577-584.

81. Maclellan RA, Greene AK. Lymphedema. *Seminars in pediatric surgery.* Aug 2014;23(4):191-197.

82. Ridner SH, Bonner CM, Deng J, Sinclair VG. Voices from the shadows: living with lymphedema. *Cancer nursing.* Jan-Feb 2012;35(1):E18-26.

83. Armer JM, Brooks CW, Stewart BR. Limitations of self-care in reducing the risk of lymphedema: supportive-educative systems. *Nursing science quarterly.* Jan 2011;24(1):57-63.

84. Brorson H. From lymph to fat: liposuction as a treatment for complete reduction of lymphedema. *The international journal of lower extremity wounds.* Mar 2012;11(1):10-19.

85. Towers A, Carnevale FA, Baker ME. The psychosocial effects of cancer-related lymphedema. *Journal of palliative care.* Autumn 2008;24(3):134-143.

86. Karlsson K, Biguet G, Johansson K, Nilsson-Wikmar L. Perceptions of lymphoedema treatment in patients with breast cancer - a patient perspective. *Scandinavian journal of caring sciences.* Mar 2015;29(1):110-117.

87. Fu MR, Ridner SH, Hu SH, Stewart BR, Cormier JN, Armer JM. Psychosocial impact of lymphedema: a systematic review of literature from 2004 to 2011. *Psycho-oncology.* Jul 2013;22(7):1466-1484.

88. Barlow S, Dixey R, Todd J, Taylor V, Carney S, Newell R. 'Abandoned by medicine'? A qualitative study of women's experiences with lymphoedema secondary to cancer, and the implications for care. *Primary health care research & development.* Oct 2014;15(4):452-463.

89. Thomas R, Hamilton R. Illustrating the (in)visible: understanding the impact of loss in adults living with secondary lymphedema after cancer. *International journal of qualitative studies on health and well-being.* 2014;9:24354.

90. Sitzia J, Stanton AW, Badger C. A review of outcome indicators in the treatment of chronic limb oedema. *Clinical rehabilitation.* Aug 1997;11(3):181-191.

91. Viehoff PB, Gielink PD, Damstra RJ, Heerkens YF, van Ravensberg DC, Neumann MH. Functioning in lymphedema from the patients' perspective using the International Classification of Functioning, Disability and health (ICF) as a reference. *Acta Oncol.* Mar 2015;54(3):411-421.

92. Orem DE, Vardiman EM. Orem's nursing theory and positive mental health: practical considerations. *Nursing science quarterly.* Winter 1995;8(4):165-173.

93. Soderhamn O. Phenomenological perspectives on self-care in aging. *Clinical interventions in aging.* 2013;8:605-608.

94. Meleis AI, Trangenstein PA. Facilitating transitions: redefinition of the nursing mission. *Nursing outlook.* Nov-Dec 1994;42(6):255-259.

95. Soderhamn O. Self-care ability in a group of elderly Swedish people: a phenomenological study. *Journal of advanced nursing.* Oct 1998;28(4):745-753.

96. Clark NM, Gong M, Kaciroti N. A model of self-regulation for control of chronic disease. *Health education & behavior : the official publication of the Society for Public Health Education.* Oct 2014;41(5):499-508.

97. Hayes SC. Role of exercise in the prevention and management of lymphedema after breast cancer. *Exercise and sport sciences reviews.* Jan 2010;38(1):2.

98. Sherman KA, Miller SM, Roussi P, Taylor A. Factors predicting adherence to risk management behaviors of women at increased risk for developing lymphedema. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Jan 2015;23(1):61-69.

99. Radina E, Armer J, Daunt D, Dusold J, Culbertson S. Self-Reported Management of Breast Cancer-Related Lymphoedema. *Journal of lymphoedema.* Oct 2007;2(2):12-21.

100. Todd M. Self-management of chronic oedema in the community. *British journal of community nursing.* Apr 2014;Suppl:S30, S32, S34 passim.

101. Ridner SH, Shih YC, Doersam JK, Rhoten BA, Schultze BS, Dietrich MS. A pilot randomized trial evaluating lymphedema self-measurement with bioelectrical impedance, self-care adherence, and health outcomes. *Lymphatic research and biology.* Dec 2014;12(4):258-266.

102. Fu MR, Kang Y. Psychosocial impact of living with cancer-related lymphedema. *Seminars in oncology nursing.* Feb 2013;29(1):50-60.

103. Teo I, Novy DM, Chang DW, Cox MG, Fingeret MC. Examining pain, body image, and depressive symptoms in patients with lymphedema secondary to breast cancer. *Psycho-oncology.* Jan 20 2015.

104. Brown JC, Cheville AL, Tchou JC, Harris SR, Schmitz KH. Prescription and adherence to lymphedema self-care modalities among women with breast cancer-related lymphedema. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Jan 2014;22(1):135-143.

105. Sagen A, Karesen R, Risberg MA. Physical activity for the affected limb and arm lymphedema after breast cancer surgery. A prospective, randomized controlled trial with two years follow-up. *Acta Oncol.* 2009;48(8):1102-1110.

106. Eickmeyer SM, Gamble GL, Shahpar S, Do KD. The role and efficacy of exercise in persons with cancer. *PM & R : the journal of injury, function, and rehabilitation.* Nov 2012;4(11):874-881.

107. Jonsson C, Johansson K. The effects of pole walking on arm lymphedema and cardiovascular fitness in women treated for breast cancer: a pilot and feasibility study. *Physiotherapy theory and practice.* May 2014;30(4):236-242.

108. Schmitz KH, Ahmed RL, Troxel AB, et al. Weight lifting for women at risk for breast cancer-related lymphedema: a randomized trial. *Jama.* Dec 22 2010;304(24):2699-2705.

109. Johansson K, Hayes S, Speck RM, Schmitz KH. Water-based exercise for patients with chronic arm lymphedema: a randomized controlled pilot trial. *American journal of physical medicine & rehabilitation / Association of Academic Physiatrists.* Apr 2013;92(4):312-319.

110. Johansson K, Klernas P, Weibull A, Mattsson S. A home-based weight lifting program for patients with arm lymphedema following breast cancer treatment: a pilot and feasibility study. *Lymphology.* Jun 2014;47(2):51-64.

111. Brown JC, John GM, Segal S, Chu CS, Schmitz KH. Physical activity and lower limb lymphedema among uterine cancer survivors. *Medicine and science in sports and exercise.* Nov 2013;45(11):2091-2097.

112. Kwan ML, Cohn JC, Armer JM, Stewart BR, Cormier JN. Exercise in patients with lymphedema: a systematic review of the contemporary literature. *Journal of cancer survivorship : research and practice.* Dec 2011;5(4):320-336.

113. Speck RM, Gross CR, Hormes JM, et al. Changes in the Body Image and Relationship Scale following a one-year strength training trial for breast cancer survivors with or at risk for lymphedema. *Breast cancer research and treatment.* Jun 2010;121(2):421-430.

114. Katz E, Dugan NL, Cohn JC, Chu C, Smith RG, Schmitz KH. Weight lifting in patients with lower-extremity lymphedema secondary to cancer: a pilot and feasibility study. *Archives of physical medicine and rehabilitation.* Jul 2010;91(7):1070-1076.

115. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports.* Mar-Apr 1985;100(2):126-131.

116. Meneses-Echavez JF, Gonzalez-Jimenez E, Ramirez-Velez R. Supervised exercise reduces cancer-related fatigue: a systematic review. *Journal of physiotherapy.* Jan 2015;61(1):3-9.

117. Sasso JP, Eves ND, Christensen JF, Koelwyn GJ, Scott J, Jones LW. A framework for prescription in exercise-oncology research. *Journal of cachexia, sarcopenia and muscle.* Jun 2015;6(2):115-124.

118. Becker BE. Aquatic therapy: scientific foundations and clinical rehabilitation applications. *PM & R : the journal of injury, function, and rehabilitation.* Sep 2009;1(9):859-872.

119. Brorson H, Hansson E, Jense E, Freccero C. Development of a pressure-measuring device to optimize compression treatment of lymphedema and evaluation of change in garment pressure with simulated wear and tear. *Lymphatic research and biology.* Jun 2012;10(2):74-80.

120. Fernandez-Lao C, Cantarero-Villanueva I, Ariza-Garcia A, Courtney C, Fernandez-de-las-Penas C, Arroyo-Morales M. Water versus land-based multimodal exercise program effects on body composition in breast cancer survivors: a controlled clinical trial. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Feb 2013;21(2):521-530.

121. Tidhar D, Katz-Leurer M. Aqua lymphatic therapy in women who suffer from breast cancer treatment-related lymphedema: a randomized controlled study. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Mar 2010;18(3):383-392.

122. Dunberger G, Thulin H, Waldenstrom AC, et al. Cancer survivors' perception of participation in a long-term follow-up study. *Journal of medical ethics.* Jan 2013;39(1):41-45.

123. Kreicbergs U, Valdimarsdottir U, Steineck G, Henter JI. A population-based nationwide study of parents' perceptions of a questionnaire on their child's death due to cancer. *Lancet.* Aug 28-Sep 3 2004;364(9436):787-789.

124. Omerov P, Steineck G, Runeson B, et al. Preparatory studies to a population-based survey of suicide-bereaved parents in Sweden. *Crisis.* 2013;34(3):200-210.

125. Lind H, Waldenstrom AC, Dunberger G, et al. Late symptoms in long-term gynaecological cancer survivors after radiation therapy: a population-based cohort study. *British journal of cancer.* Sep 6 2011;105(6):737-745.

126. Barnard A, McCosker H, Gerber R. Phenomenography: a qualitative research approach for exploring understanding in health care. *Qualitative health research.* Mar 1999;9(2):212-226.

127. Malterud K. Qualitative research: standards, challenges, and guidelines. *Lancet.* Aug 11 2001;358(9280):483-488.

128. Friberg F, Dahlberg K, Petersson MN, Ohlen J. Context and methodological decontextualization in nursing research with examples from phenomenography. *Scandinavian journal of caring sciences.* 2000;14(1):37-43.

129. Sjostrom B, Dahlgren LO. Applying phenomenography in nursing research. *Journal of advanced nursing.* Nov 2002;40(3):339-345.

130. Brorson H, Hoijer P. Standardised measurements used to order compression garments can be used to calculate arm volumes to evaluate lymphoedema treatment. *Journal of plastic surgery and hand surgery.* Dec 2012;46(6):410-415.

131. Taylor R, Jayasinghe UW, Koelmeyer L, Ung O, Boyages J. Reliability and validity of arm volume measurements for assessment of lymphedema. *Physical therapy.* Feb 2006;86(2):205-214.

132. *Joint Motion.* Edinburgh, UK, E & Livingstone: American Academy of Orthopaedic Surgeons; 1995.

133. Riddle DL, Rothstein JM, Lamb RL. Goniometric reliability in a clinical setting. Shoulder measurements. *Physical therapy.* May 1987;67(5):668-673.

134. Watkins MA, Riddle DL, Lamb RL, Personius WJ. Reliability of goniometric measurements and visual estimates of knee range of motion obtained in a clinical setting. *Physical therapy.* Feb 1991;71(2):90-96; discussion 96-97.

135. Atroshi I, Gummesson C, Andersson B, Dahlgren E, Johansson A. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: reliability and validity of the Swedish version evaluated in 176 patients. *Acta orthopaedica Scandinavica.* Dec 2000;71(6):613-618.

136. Hoang-Kim A, Pegreffi F, Moroni A, Ladd A. Measuring wrist and hand function: common scales and checklists. *Injury.* Mar 2011;42(3):253-258.

137. Thorborg K, Roos EM, Bartels EM, Petersen J, Holmich P. Validity, reliability and responsiveness of patient-reported outcome questionnaires when assessing hip and groin disability: a systematic review. *British journal of sports medicine.* Dec 2010;44(16):1186-1196.

138. Nilsdotter A, Bremander A. Measures of hip function and symptoms: Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), Lequesne Index of Severity for Osteoarthritis of the Hip (LISOH), and American Academy of Orthopedic Surgeons (AAOS) Hip and Knee Questionnaire. *Arthritis care & research.* Nov 2011;63 Suppl 11:S200-207.

139. Shiöler A. *To measure body-awareness.* Institution of Psychology, Stockholm University, Sweden; 1998.

140. Steineck G, Hunt H, Adolfsson J. A hierarchical step-model for causation of bias-evaluating cancer treatment with epidemiological methods. *Acta Oncol.* 2006;45(4):421-429.

141. Beesley V, Eakin E, Steginga S, Aitken J, Dunn J, Battistutta D. Unmet needs of gynaecological cancer survivors: implications for developing community support services. *Psycho-oncology.* Apr 2008;17(4):392-400.

142. Beaulac SM, McNair LA, Scott TE, LaMorte WW, Kavanah MT. Lymphedema and quality of life in survivors of early-stage breast cancer. *Archives of surgery.* Nov 2002;137(11):1253-1257.

143. Jager G, Doller W, Roth R. Quality-of-life and body image impairments in patients with lymphedema. *Lymphology.* Dec 2006;39(4):193-200.

144. Johansson K, Tibe K, Weibull A, Newton RC. Low intensity resistance exercise for breast cancer patients with arm lymphedema with or without compression sleeve. *Lymphology.* Dec 2005;38(4):167-180.

145. Jonsson C, Johansson K. Pole walking for patients with breast cancer-related arm lymphedema. *Physiotherapy theory and practice.* Apr 2009;25(3):165-173.

146. Ridner SH, Dietrich MS, Stewart BR, Armer JM. Body mass index and breast cancer treatment-related lymphedema. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* Jun 2011;19(6):853-857.

147. Karlsson K, Biguet G, Johansson K, Nilsson-Wikmar L. Perceptions of lymphoedema treatment in patients with breast cancer - a patient perspective. *Scandinavian journal of caring sciences.* Apr 9 2014.

148. Von Korff M, Moore JC. Stepped care for back pain: activating approaches for primary care. *Annals of internal medicine.* May 1 2001;134(9 Pt 2):911-917.

149. Sculpher M, Millson D, Meddis D, Poole L. Cost-effectiveness analysis of stratified versus stepped care strategies for acute treatment of migraine: The Disability in Strategies for Care (DISC) Study. *PharmacoEconomics.* 2002;20(2):91-100.

150. Scogin FR, Hanson A, Welsh D. Self-administered treatment in stepped-care models of depression treatment. *Journal of clinical psychology.* Mar 2003;59(3):341-349.

151. Ahlberg K, Nordner A. The importance of participation in support groups for women with ovarian cancer. *Oncology nursing forum.* Jul 2006;33(4):E53-61.

152. Schmitz KH, Neuhouser ML, Agurs-Collins T, et al. Impact of obesity on cancer survivorship and the potential relevance of race and ethnicity. *Journal of the National Cancer Institute.* Sep 18 2013;105(18):1344-1354.

153. Dahl AA, Nesvold IL, Reinertsen KV, Fossa SD. Arm/shoulder problems and insomnia symptoms in breast cancer survivors: cross-sectional, controlled and longitudinal observations. *Sleep medicine.* Jun 2011;12(6):584-590.

154. Lindquist H EA, Bergmark K. Self-care among female cancer survivors with secondary lymphedema- a qualitative study. *Rehabiltation Oncology.* April 2015 2015;33(1):51-57.

155. Cantarero-Villanueva I, Fernandez-Lao C, Cuesta-Vargas AI, Del Moral-Avila R, Fernandez-de-Las-Penas C, Arroyo-Morales M. The effectiveness of a deep water

aquatic exercise program in cancer-related fatigue in breast cancer survivors: a randomized controlled trial. *Archives of physical medicine and rehabilitation.* Feb 2013;94(2):221-230.

12 APPENDIX

Below, I present some of the questions as they were printed in the questionnaire (in English):

Now we continue with some questions about how you are feeling**.**

28. How do you evaluate your present state of well-being?

1……...2……...3…….4…….5……...6…….7
No experience at all of well-being (1) to best possible feeling of well-being (7).

47. I am ashamed of my body or parts of it.

- ❑ Strongly disagree
- ❑ Slightly agree
- ❑ Moderately agree
- ❑ Strongly disagree

48. It is difficult for me to accept and like my body as it appears at present.

- ❑ Strongly disagree
- ❑ Slightly agree
- ❑ Moderately agree
- ❑ Strongly disagree

49. I do not like to/avoid seeing myself in the mirror when I am naked.

- ❑ Strongly disagree
- ❑ Slightly agree
- ❑ Moderately agree
- ❑ Strongly disagree

50. I can no longer rely on my body.

- ❑ Strongly disagree
- ❑ Slightly agree
- ❑ Moderately agree
- ❑ Strongly disagree

51. My body feels damaged.

- ❑ Strongly disagree
- ❑ Slightly agree
- ❑ Moderately agree
- ❑ Strongly disagree

52. My body feels strange (foreign)

- ❑ Strongly disagree
- ❑ Slightly agree
- ❑ Moderately agree
- ❑ Strongly disagree

53. Can you accept your body as it now appears?

- ❑ No, not at all
- ❑ Yes, a little bit
- ❑ Yes, moderately
- ❑ Yes, very much
- ❑ Nej, inte alls
- ❑ Ja, lite
- ❑ Ja, måttligt
- ❑ Ja, mycket

94. What do you do when you take care of your lymphedema? What we usually call self-care.

Please place a cross on every line	
Self-massage	❑ No ❑ Yes
Massage apparatus	❑ No ❑ Yes
Bandaging during the day	❑ No ❑ Yes
Bandaging at night	❑ No ❑ Yes
Compression stockings and/or	❑ No ❑ Yes
Cool	❑ No ❑ Yes
Skin care	❑ No ❑ Yes
Raise my arm or leg/legs	❑ No ❑ Yes
Breathing exercises	❑ No ❑ Yes
Physical activity	❑ No ❑ Yes
Recover/rest	❑ No ❑ Yes
Use technical aids (for example at the computer or in the kitchen)	❑ No ❑ Yes
Get help from others	❑ No ❑ Yes
Adapt my work to existing conditions	❑ No ❑ Yes
Adapt my day to existing conditions	❑ No ❑ Yes

Please tell us more about how you adapt or shape your work/day as well as other personal activities

.....

.....

.....

95. Have you developed **good routines** for taking care of your lymphedema?

- ❑ No, not at all
- ❑ Yes, to some degree
- ❑ Yes, in large part
- ❑ Yes, completely

96. Do you have the **time** you need in order to take care of your lymphedema?

- ❑ No, not at all
- ❑ Yes, to some degree
- ❑ Yes, in large part
- ❑ Yes, completely
- ❑ No, not at all
- ❑ Yes, to some degree
- ❑ Yes, in large part
- ❑ Yes, completely

97. Do you feel that the people **around you c**an provide support and help when you practice yourself care?

- ❑ No, not at all
- ❑ Yes, to some degree
- ❑ Yes, in large part
- ❑ Yes, completely

98. Do you feel that being close to a pet **c**an help when you practice yourself care?

❑ Not at present, I do not have any pets

- ❑ No, not at all
- ❑ Yes, to some degree
- ❑ Yes, in large part
- ❑ Yes, completely

99. Do you feel that the treatment/training you get from **health care personnel/other caregivers** helps you with your lymphedema?

❑ Not at present, I have not got any help from caregivers.

❑ No, not at all
❑ Yes, to some degree
❑ Yes, in large part
❑ Yes, completely

100. Do you think that the self-care you carry out helps you with your lymphedema?

❑ Not at present, I do not carry out any self-care.
❑ No, not at all
❑ Yes, to some degree
❑ Yes, in large part
❑ Yes, completely